AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 17, NO. 11. WEEKLY. | NEW YORK, THURSDAY, MARCH 15, 1894. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Thirty-inch Vertical Chucking and Facing Machine.

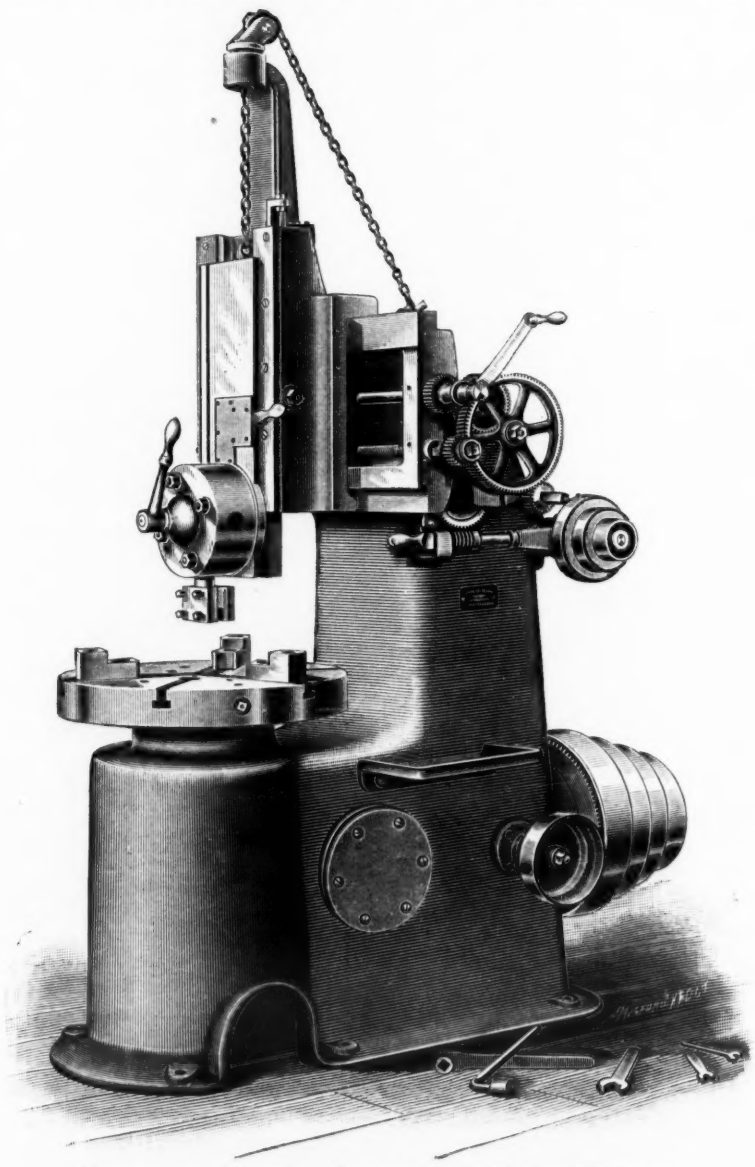
The accompanying engraving is of a new vertical chucking and facing machine with turret.

It will be noticed that the bed, upright and cross-rail are all one piece, and that piece so designed and proportioned as to give very great rigidity and strength. The table of the machine is 24″ diameter, and is fitted with a three-jaw universal chuck, the jaws of which are so made as to be easily removed, thus leaving top of table plain.

It is powerfully driven by a stepped pulley at the back with back gears, which, with two speeds provided for the countershaft, gives 16 rates of speed for the work.

Automatic lateral and vertical feeds are provided by the mechanism plainly shown in engraving. Vertical feed ranges from $\frac{1}{20}$″ to $\frac{1}{80}$″ per revolution, and cross-feed from $\frac{1}{10}$″ to $\frac{1}{40}$″ per revolution. The downward movement of turret slide is 16″, and it will face 24″ diameter, the machine swinging 30″ diameter in front of column, 14″ high. Turret is 10″ diameter and has four $1\frac{3}{4}$″ holes.

Countershaft has 16″ and 20″ driving pulleys and should run at 75 and 250 revolutions. Machine weighs 4,000 pounds. It is built by the Bridgeport Machine Tool Works, Bridgeport, Conn.



THIRTY-INCH VERTICAL CHUCKING AND FACING MACHINE.

Experiment and Experience.

BY B. F. SPALDING.

When I was an apprentice at the blacksmith trade, I had a much prized opportunity of helping a steel workman, who was intolerant of any imperfection in his work. He scorned to do any less than a perfect job, he would not slight it for fear or favor, hurry or fret. When he laid it down it was as good as he could make it, and he could make it as good as anybody. He wasn't a bit old-maidish; he didn't putter with his work, but from the beginning to the end it moved straight along with free and easy strides; he made no mistakes and wasted no time in correcting errors.

I remember one forenoon, when I struck for him to forge a difficult piece of steel. He finished it in his usual manner in the highest style of the art; the squares were square, the flats were flat, the rounds were round, straight lines were straight, and curved lines were regular, outside corners were true and sharp, and inside corners were free from cold shuts, and slightly rounding, as though with a fillet. There was a ball on one end of it, and a neck joined it to the body.

I joined with him in the satisfaction he manifested as, when the bell struck twelve for the noon intermission, he laid the smooth, scaleless, flawless forging, blue and complete, upon the cast-iron upsetting block which was bedded in the earth floor between the forge and the anvil.

The perfect sphericity of the ball was our especial pride. But when we came back from dinner our forging was in ruins. The neck was broken in the middle, and half of it would have had to be chipped off before you could have rolled tenpins with the balled head. The fracture disclosed no flaw, it was through the solid metal; the proof was visible that the break occurred when the piece was nearly cold, for there was no discoloration, the fracture was bright. If it had been caused by a blow the break would have been at the end, instead of in the middle of the straight, cylindrical neck. I have had similar experiences in hardening, but only this of rupture in the slow cooling of a sound piece of steel.

I do not know of anything which could be assigned as a cause, except it was some internal strain set up by letting the forging lie upon the iron upsetting block to cool from a blue heat. The experience taught me not to lay hot steel to cool on any good conductor of heat, without making arrangements to have it cool uniformly. It was one of the first things which impressed upon my mind the lesson, which a thousand later incidents have deepened, that steel is so susceptible to damage and so sensitive in its nature, at certain temperatures, that injurious strains may be produced by apparently trivial causes, and hence, that the good steel workman cannot maintain too vigilant guard against aggressive evils that come in every form and constantly seek to evade his caution.

Everything we know must be what some one has told us, or what we find out for ourselves by observation and experiment. Experience is the best master, and he spares not the rod. Someone has said, in the AMERICAN MACHINIST, that he wouldn't give much for a boy that never spoiled a drill. Not that the act of breaking a drill is in itself meritorious, but not to break drills, argues that the boy never tried to see how much the drill would do, and didn't know by actual experiment how much it was safe to force it. Such an experiment could not be successful until the drill broke, the success of the experiment depended upon the failure of the drill. Experience is the sum of experiments. The value of experience is rated by the amount of serviceable information it stores on draught; it depends upon acuteness and comprehensiveness of observation, and readiness of recollection at the touch of occasion. It must be on hand when wanted.

Recorded experiment is available in printed form, and serves to convey information to guide or to warn, and mechanical journals are the best mediums for the interchange of mechanical experience. They yield the benefits of weekly meetings for discussion on a wide variety of subjects, at the family fireside, without subjecting the beneficiary to the inconvenience of leaving home. We like to read of the experiments of others with like interest to that we have in trying them for ourselves. As to failure it seems that any experiment should be accounted a success which satisfactorily determines a mooted point, even though the question is settled in a manner unfavorable to the expectations of the projector.

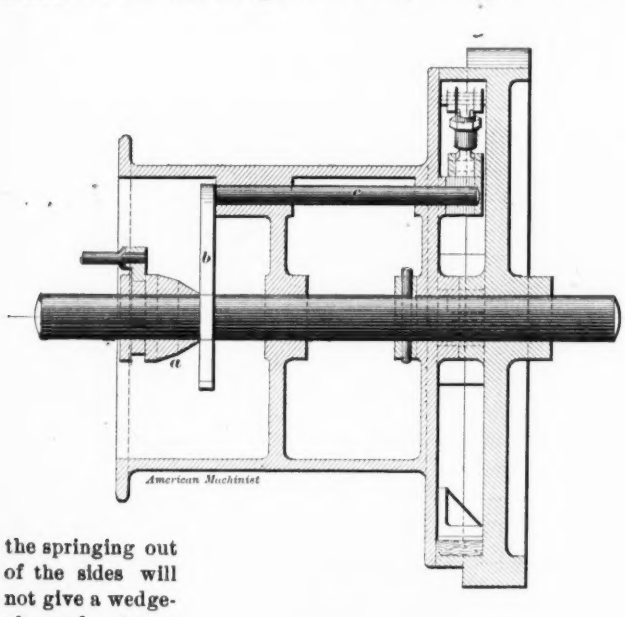
A steel drop die, 12 inches long, split through the center from the top down into the tenon, and from end to end. The impression was $\frac{3}{4}$ inch deep, running to within an inch and a half of one end, and the sprue cut through the other end. I drove the crack together, and then tried an experiment to see if I could fasten it there. It would take some time to get a new one, and I wanted to keep the demand for the work supplied in the meantime. Three holes were drilled in the die from side to side, the tops of the holes coming as near as was safe to the bottom of the impression just so they did not break through. These holes were $1\frac{3}{8}$ inches in diameter, and were counterbored on each side to take a head like the head of a wood-screw, except that the angle of a wood-screw head is 90° and these were but little over 40°. The countersinks at the outside were $2\frac{1}{2}$ inches diameter, and they were $1\frac{1}{4}$ inches deep. At the wood screw angle they would have been 3 inches diameter outside, which would have been better. Three rivets were then made for them of "decarbonized" gun barrel steel, and one end of each was headed to fit the countersinks; then the other end of one of them was heated and passed through the die, it was given a couple of blows with a sledge to get rid of scale, and then put under the drop and headed down solid with blows from the drop-hammer; the same course was pursued with the two others. Thus the die was held together by three steel rivets $1\frac{3}{8}$ inches in diameter with large countersunk heads riveted hot with ample force.

Mending broken dies is liable to come under the head of a premeditated botch, but emergencies suggest strange expedients. It is said that a highwayman was once frightened away as effectually with a crooked sausage as if it had been a pistol. We never know what anything will do till we try it. My experiment was a success, so far as that I found out what that riveting amounted to, but the effort to hold the die together with it was a failure. Of course, the riveting remained, but the crack opened a sixty-fourth of an inch at the first blow, and the next one left it a thirty-second of an inch wide. "I'll wait till you get some new dies," said the contractor.

Broken dies may sometimes be repaired by banding. Success in this effort can only be assured by making the bands so large that they will be stronger than the original die, for if that had been strong enough it would not have broken. The band must also have so much of its inner surface in contact with the die as to resist indentation. The cause of the opening of the crack in the riveted die may not have been so much in the stretching of the rivets, as the very slight indenting of the heads, which, on account of their acute angle, would permit them to enter. If the angle had been more obtuse they might have offered resistance more bluntly and effectually against the sudden impulse. Bands need not have as great cross-section as the

fracture of the die represents, yet be stronger; hardened steel is weak against the sudden stress of impact, or shock. Such attacks are resisted more successfully by iron ordinarily hard. If it is too soft it will act like a lead ring fitted tight around a gun barrel, which will become loose when the barrel is discharged, and, in proportion to its softness, indicate the amount of expansion of the barrel.

The binding power of the band, sidewise, at the ends of the die depends upon the tensile strength of that part of the band which crosses the ends of the die, but to determine the power to bind crosswise of the middle of the die, or at any intermediate point between the ends, the capacity of the side of the band to resist flexion must also be considered. This consideration will also suggest that the principle is to be observed in making a new die, which, on this account, should be made wide enough to insure that the springing out of the sides will not give a wedge-shaped stress across the ends.



In shrinking the bands upon the dies, some precautions should be taken to prevent their slipping when they are jarred by the dies striking together. Some arrangements should be made to stop them simultaneously with the dies and independent of their original hugging power, such as making them even with the faces of the dies, so that the bands will strike at the same time, or making the shape of the dies such that the bands will tighten on them with the jar. Something in this way may be done by grinding the corners. It is not best, any way, to have the inside corners of the bands sharp, and in grinding off the corners of the dies to let the bands on, it is just as easy to take off more towards the tenons, so that across the corners the dies will be larger on the face, then, by putting the bands on from the tenon sides, they will tighten across the corners as they tend towards the face by the jar of the drop.

The best shape of a die to be banded would be round, for the band would be circular, and in this form it could be made to resist stress in every direction with the greatest strength. The nearer the dies are made to approach this shape by taking the corners off from square dies, the more efficient will be the reinforcement given by the band against forces tending to strain the die in every direction.

Metallic water pipes of oval cross section are less liable to burst from freezing than round pipes, but this is not because the oval pipe is stronger, it is simply less rigid; it does not burst, because when the expansion of congelation takes place it is accommodated by a change in the shape of the pipe from oval to round, which gives it additional space for its swelling contents.

Circular bands have such manifest strength that every little while some account finds its way into the papers of some newly invented cannon which claims superiority to all others on account of the use of such bands. One instance—which may be adduced to show that this appreciation of their excellence is not new—is that of a cannon which went down in the "Mary Rose," a British war vessel which sunk in 1545, during the latter part of the reign of Henry VIII., and was raised not many years ago, when it was found to be constructed of a central wrought-iron tube, upon which were shrunk a succession of rings, made of wrought iron, three inches square. This old gun presents evidence that the utility of bands was so plainly manifested by their common use and had become so well recognized that they were employed at an early period to strengthen ordnance.

William Denning, a Pennsylvania blacksmith of Cumberland County, during the Revolution, has still in existence two monuments of his belief in the efficacy of wrought-iron bands—one is in the Tower of London, and another in the Philadelphia Arsenal. They are wrought iron cannon. They are described as "made of wrought-iron staves, hooped like a barrel, with bands of the same material, excepting that there are four layers of staves, breaking joint, all of which are firmly bound together, and then boxed and breeched like other cannon." His obituary says he died in 1830, 94 years old, that his was the only successful attempt ever made to manufacture wrought-iron cannon, and that he could get no one to assist him that could stand the heat, which was said to be so great as "to melt the lead buttons on his clothes."

Excepting a limited class of forgings, such as dropping round work endwise, the stress on dies is greatest in some particular direction. It generally tends to split them lengthwise, and the bands must be made to suit the circumstances.

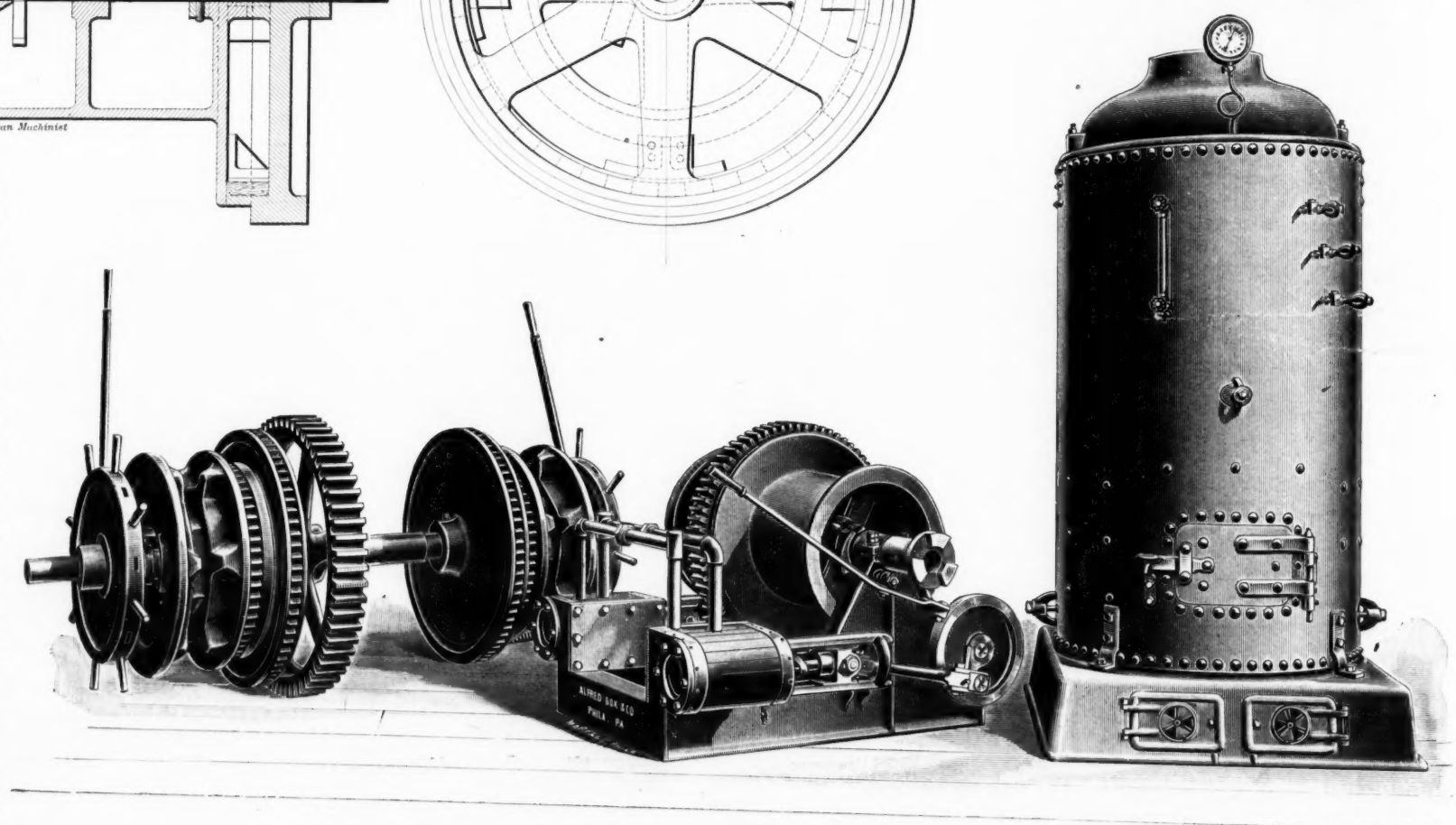
The effect of putting substantial bands upon new dies is much the same as compounding dies, in the manner described in the American Machinist, July 20, 1893. A block of steel of die temper containing the impression is set into a recess, cut to receive it, in a block of steel large enough to supply the requisite strength. The impression die is hardened, but the receiving block may be made of steel, low in carbon, or of wrought or cast iron. This method is better adapted to save steel than the process of banding. The impression die can be made smaller, as the arrangements for fastening into the drop are made on the receiving block, thus doing away with planing tenons. But, in cases where the quantity of forgings required is liable to be limited, and the faces are necessarily of such irregular contour as prevents the dies from being used to advantage in the common recessed die blocks, they are frequently used with satisfactory economy when reinforced with duly proportioned iron bands.

It is a rather well known fact that a man is more given to improving something about which he knows very little than something with which he is entirely familiar. A very large proportion of patent-office failures come from this intention to make better things that those using them know perfectly well cannot be remedied in the way proposed. But there is a redeeming feature to all this. Nothing so well satisfies the mining machine man that his devices will not perfect the steam engine as a trial, and the securing of a patent preparatory to the trial. Everybody seems to learn in a similar way, and perhaps, after all, it is the best way.

A Steam Plant for Sailing Vessels.

We present on this page illustrations which will give an idea of a form of power plant used largely on sailing vessels, for loading and unloading cargo, hoisting anchor, handling sails, etc., an incidental feature being that, with suitable pumps added, decks can be washed, the ship pumped out in case of a leak, or a fire put out by hose, all these services being performed much more efficiently than can possibly be done by hand work; which efficiency manifests itself in the fact that sailors who have once worked in a ship so equipped always afterwards prefer ships so equipped, and that underwriters favor it.

The engraving does not, of course, show the different parts of the plant in their true positions relative to each other, but is simply so arranged as to show in one view the more important portions. At the right is the boiler, about which little needs to be said, except that it is of the most approved construction as regards material and workmanship. At the extreme left is the anchor windlass, which is so arranged as to be worked by hand, if necessary, and, in fact, in most cases is a windlass already in place, to which is fitted the large spur gear shown near the center of the shaft, this being driven by a pinion which gets its motion from the drum shaft at the engine, through the medium of a "messenger chain"—the nautical term for a driving chain, which acts simply as a belt or driving chain to transmit motion from engine to windlass.



A Steam Plant for Sailing Vessels.

The engine is, as usual, double, and drives by pinion and gear a drum which is placed above the crank shaft. This drum is driven by a friction clutch, which can be easily handled so as to act as a very efficient and reliable brake for lowering, while at the same time both ends of the shaft are left clear for connecting to windlass and catheads.

This, we understand, is an unusual feature and the construction by which it is accomplished is shown in the detail engraving at top, where *a* is a sliding cone, moved upon the shaft by the usual fork. As it slides forward it moves the lever *b*, which is attached to the end of the shaft *c*, which is journaled in the drum, this shaft having at its other extremity a short lever, which is connected, as shown in the end view, to a toggle joint. The toggle joint is connected to either end of a steel band, which is covered with wood blocks that bear against the inside of a flange cast upon the

large spur gear. Adjustment is provided for the toggle joint as shown, to provide for wear.

It will be perceived that the clutch, so arranged, is positive in its action for both tightening and loosening, and that it is easily possible to apply it with any desired pressure when used as a brake in lowering; the various inclinations of the surface of the cone *a* being found to greatly facilitate this.

The engraving was made from an engine having cylinders 6″x10″, but they are built all sizes from those suitable for small steam yachts up to the largest ships, and often, a surface condenser is added, in which case there are usually two pumps of the Worthington type; the smaller one used for a circulation pump, etc., while the larger one is for fire protection, or pumping ship, mainly.

The builders are Alfred Box & Co., 312 to 316 Green street, Philadelphia, Pa.

Philadelphia Shop Notes.

WM. SELLERS & CO.

Though not nearly so much work was being done in the machine shops of Philadelphia at the time of a recent visit there, as is usually the case, the machinery interests of the city are so vast, and its machinists have so acquired the habit of original work, that times would have to be much more dull than at present to make it impossible to find things of interest there.

At Wm. Sellers & Co.'s place they were running on short time, with 350 men employed, the business in their latest improved electric cranes constituting a large proportion of the work in hand.

As is well known, the craft is under many obligations to this firm for the thorough, careful and expensive experiments which it has conducted at various times, and the results of which have been given in full and in detail for general information and use.

EXPERIMENTS WITH BALL BEARINGS.

At present one of the things that mechanics want to know about is the ball bearing. Such use as these have been put to, other than in bicycles, shows that they undoubtedly have great value, if properly proportioned and constructed with reference to the work they have to do; but no one knows just what is proper proportion and construction. There will, in all probability, be a better chance of knowing something about this when experiments now being made under the direction of Mr. J. Sellers Bancroft are completed. These have not, as yet, gone far enough to enable me to give any account of them, but it can be said that the special apparatus already constructed, and which I saw, indicates that the experiments when completed will be of the greatest value.

For determining frictional resistance of ball bearings a revolving disk will drive another parallel, concentric, and similar disk a short distance away, through the medium of three pins placed equidistant from each other, and the ends of which rest upon the opposing faces of the disks. These pins are not rigidly attached to either disk, and instead of standing up vertically, or parallel with the axis upon which the disks revolve, are inclined to an angle of 45° in the direction in which they drive; the result being that they tend, in driving, to assume a vertical position, and thus separate the disks; the force with which they tend to do this being just equal to the rotary force required to drive the driven disk. This force thus becomes easily weighable by what is the equivalent of a scale beam, and things are so arranged that accurate calibration is easy; and different hardened steel rings for various sized balls are readily put in.

It is proposed to test balls up to quite large sizes, and one of the first things done is to find out how much load can be borne by different sized balls resting upon various forms of surfaces, up to the point of objectionable or permanent deformation of ball or track. For this purpose the latest form of Emery testing machine as made by Wm. Sellers & Co. is being used, and altogether it seems probable that machinists may be congratulated upon the prospect of possessing some accurate and definite knowledge upon the subject of ball bearings.

A SPECIAL TESTING MACHINE.

One of the latest examples of testing machine construction, by the way, stood, partly constructed, upon the erecting floor of the shop. It is to go to the Pope Manufacturing Company, of Hartford, and will have a capacity up to 100,000 pounds. It is of the horizontal type, and is raised a sufficient distance from the floor, and with one of the tie-rods (which in this machine are used in place of the usual straining screws) raised above the other one, to make it convenient to place a complete bicycle frame in the machine and take it out again by horizontal movement.

It will be remembered that the original Emery testing machine, which is now at Watertown, and which was illustrated and described in this journal in issue of July 21, 1883, has large straining-screws at either side which are held stationary, and upon which nuts are revolved to move the straining head to or from the weighing-head. Mr. Emery was exceedingly particular in the matter of getting these screws precisely uniform in pitch from one end to the other, so that the nuts, revolved at uniform rates together, should always hold the straining-head precisely square, and with its piston exactly in line with the center line of the weighing head. This was important, of course, for obvious reasons; but Wm. Sellers & Co., in working over the design of this machine, eliminated this expensive refinement, and provided for irregularities of pitch by introducing a balanced train of gearing that rotates each nut independently, and thus delivers an equal pressure against each side of the straining-head when moving it and compensating for irregularities, either original, or resulting from unequal wear.

A NICE JOB OF MACHINE WORK

In some of the smaller machines, however, the screws are not used, but instead of these there are two plain cylindrical rods, or bars

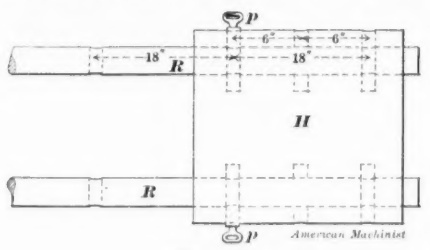


Fig. 1

of steel, along which the straining head is pushed and secured at any desired point by pins passing through the rods at right angles to its axis.

In the case of the particular machine referred to above, these holes are spaced 18 inches apart, while those in the movable head are 6 inches apart, and there are three pairs of them, so that the head can be secured at intervals of 6 inches anywhere on the rods. The arrangement is shown by the sketch, Fig. 1, in which *R R* are the rods, and *H* the straining head. The pins *p p* have handles for convenience in pulling them out and inserting them, and are lapped to fit the holes. A little examination of the matter will show that some very accurate work must be done on these holes in order that the pins will always go in freely and bear the strain equally on each side, as it is important they should. The sketch is not to scale, nor does it pretend to reproduce the outlines of the machine, but it will serve to make plain the principle of what must necessarily be a very nice job of machine work.

THE PEDRICK & AYER CO.

At the Pedrick & Ayer shops, Mr. Pedrick was taking advantage of dull times, and a rearrangement of the affairs of the firm consequent upon its late financial troubles and retirement of Mr. Ayer, to devise some new tools, among them a milling machine of much the same style as their regular universal milling machine, but having, instead of the usual horizontal spindle, a vertical one, which is at the end of a cylindrical arm, through the center of which arm passes a horizontal shaft that, by miter gears, drives the spindle. By rotating the arm the spindle is set at any desired inclination to the vertical, and can then be clamped. The machine is intended for heavy work, and to use radial cutters mainly.

They are also preparing to bring out the large vertical milling machine which was originally designed by Mr. George Richards and built by him at Broadheath, England. This machine is a very noteworthy one, as those who remember our illustration and description of it in issue of December 5, 1889, know. Experience with the machine as then shown has, however, developed the fact that a longer spindle would be an improvement, and also that the front side of the uprights should be carried back near the bottom to give more room for the work being operated upon; and these, with some minor changes, have been made in the design.

A settlement of the affairs of the late firm of Pedrick & Ayer shows that, so far as its own legitimate business was concerned, there need not have been any serious trouble; and now that its affairs have been reorganized, Mr. Pedrick has confidence that there will be smooth sailing The selling agents and business managers of the reorganized company will be the New York firm of Manning, Maxwell & Moore, which fact gives assurance that there will be business management, and plenty of capital for carrying on the business.

EDWIN HARRINGTON, SONS & CO.

At these works, with which Mr. J. A. McGregor, late assistant superintendent of the Brown & Sharpe shops, has recently identified himself, they are revising their methods, with the intention, evidently, of doing things by the most modern methods possible to introduce.

The most notable improvement, possibly, is in the organization and equipment of a tool room, in which are to be found the usual tool makers' tools, including a B. & S. surface- a universal- and a universal tool and cutter-grinder.

Something remarkable was shown me here in the way of a broach for finishing square holes in cast-iron, but as arrangements are in progress for its complete illustration it is unnecessary to say more of it now.

Mr. McGregor is a believer in adjustable reamers where it is important that work should be kept within certain narrow limits of variation, and is making them with inserted teeth dovetailed into place, and with wedges under them at the bottom of each dovetailed slot. When the reamer gets too small the teeth are forced out by driving these wedges; the metal at the sides of the dovetailed slots yielding sufficiently to permit this. It is his practice, too, to sharpen the teeth by oil stoning, and then set them out by an indicator used in the lathe the same as for truing any other kind of work, the reamer being revolved upon centers, or if a shell reamer, upon an arbor. By not making the angle of the dovetail too great — probably about 3 degrees is right—the amount of adjustment possible by this method is considerable, and the teeth are very firmly held. The front sides of the dovetailed slots are radial.

For facing off a surface about a counterbored hole in their chain hoist they are making a form of counterbore which has some unique features.

At Fig. 2 is shown a sketch of the work. The hole and the counterbore are previously made, and the tool is to face off the top surface *f f*, which must be an exact distance from the bottom of the counterbore.

The tool is made about as shown at Fig. 3, in which *S* is the shank, *C* the cutter, and *c* a hardened and ground ring threaded onto the shank. The thickness of this ring is exactly equal to the desired depth of counterbore, while its diameter is equal to diameter of counterbore, and all that is necessary is to grind the edge of the cutter square with that side of it which bears against the

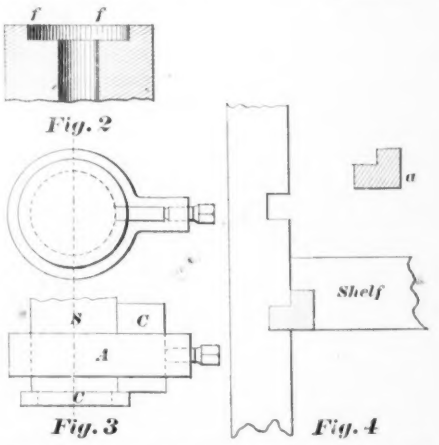


Fig. 2 *Fig. 3* *Fig. 4*

shank *S*, then put the edge down onto the upper surface of the ring *c*, clamp it in place by the set-screw in the clamping collar *A*, and then face until the ring *c* strikes the bottom of counterbore. These are nothing more than what Mr. Arnold would call impressionist sketches, but will serve to give the idea.

I noticed in the new cupboards that have been put up to hold tools that they have a scheme for holding the shelves at any desired distance from each other, that is admirable and was new to me, though Mr. McGregor said it had been used at Brown & Sharpe's for some time, originating, he thought, with Mr. Parks or Mr. Hatch. This is shown at Fig 4, where a portion of a shelf is shown and a portion of the upright, having rectangular notches at one side close enough together to enable the shelves to be placed at any desired point. What supports the shelf is the strip of cast-iron shown separately at *a*, these strips being of a length equal to the depth of the shelf.

The arrangement gives a very strong support and one that allows very easy adjustment.

F. J. M.

In an Incandescent Lamp Factory.

The beautiful little glow lamp, with its fragile bulb and delicate filament, is a far more interesting production than its massive and cumbersome progenitor, the arc lamp. In our rapid tour through the incandescent lamp factory we are more struck than ever by the share that female labor takes in the electrical industries. We know that the inhabitants of "Central" all belong to the gentler sex, and that the telegraph key is often handled by the nimble fingers of a woman; in the factories that we have already visited we have seen girls busily employed in winding fine wire on the spools of small electro-magnets for telegraph and telephone instruments, and coarser wire on the armatures of small dynamos and motors, and in many other of the lighter and finer tasks incident to electrical manufactures. Electricity has opened many new avenues of employment for women who have to earn their own living; the work is almost always of an attractive nature, and as increased skill is acquired with practice and experience, a very satisfactory rate of pay, compared with that which obtains in other industries where female labor is largely used, is attained.

As we pass from one part of the lamp factory to another we see the little bulbs in a formative stage, like a small bottle with a neck at each end, in one place, the carbon filaments in another, the bases and connecting wires in a third, the finished lamps in a fourth. The process of manufacturing the carbon filaments from bamboo threads is a long and intricate one, and is carried on in strict seclusion as a trade secret. But we can see the quick-fingered girls pick up the hair-like filaments and join them to the little

pieces of platinum wire which are fused into the neck of the bulb; to the platinum wires are soldered other pieces of copper wire, which connect with the brass screw cap and button, insulated from each other by plaster of paris, that form the base of the lamp.

When the filament is inserted in the bulb and the base sealed up, the tube which projects from the top of the bulb is connected to a mercury air pump to exhaust the air from the bulb; this done, the tube is cut off and the bulb sealed up at the same moment, leaving the little point or cone that is to be seen on the top of all incandescent lamps. There are many intermediate operations in the evolution of the glow lamp, and every part of the work is checked by the most careful supervision, and each lamp is closely examined and tested before being wrapped and packed for shipment. The carbon filaments must be accurately measured and their resistance tested, the platinum wires must be just so long—or rather just so short—and no longer, every joint and connection must be perfect, and every juncture of glass with metal must be rigorously airtight.—*Harper's Weekly.*

Said the old time machinist: "I see you are having some discussion of how to prevent holes in the cast iron top of a small boiler, and several of your contributors have shown how to avoid them. Perhaps my way of doing this is not new or particularly novel, but it worked very successfully years ago when I was having some similar work done. The boilers were somewhat larger than these, and the first two of them had holes in them and were no account. I just took them under the drop and broke'm up and then went into the foundry and swore at the boss molder for about half an hour, and there was no more trouble from that source. I don't know what the molder did, but I know what I did, and it worked, too."

There is no doubt sometimes a good deal of friction in large Corliss valves before they get worn down smooth on their seats. I once knew a vertical Corliss engine, with a cylinder about 40 inches, that gave no end of trouble with the steel latch dies for about a month after starting. Then the trouble had disappeared so gradually that no one knew when it ceased.

Triple Drum Power Feed Sand-papering Machine.

For the character of surface required on fine wood-work which is to be finished by varnishing or painting, a demand has arisen for an efficient machine to produce such a surface by sand-papering. Several such machines have been produced and improved upon from time to time, the machine illustrated herewith being an improved form of what has been known as the "Conqueror," and now called the "New Conqueror."

As will be perceived, it is a very heavy and substantial machine, especially when the character of the work to be done by it is considered, experience having demonstrated that such a machine in order to do the very best of work must be so substantially constructed as to absolutely prevent vibration.

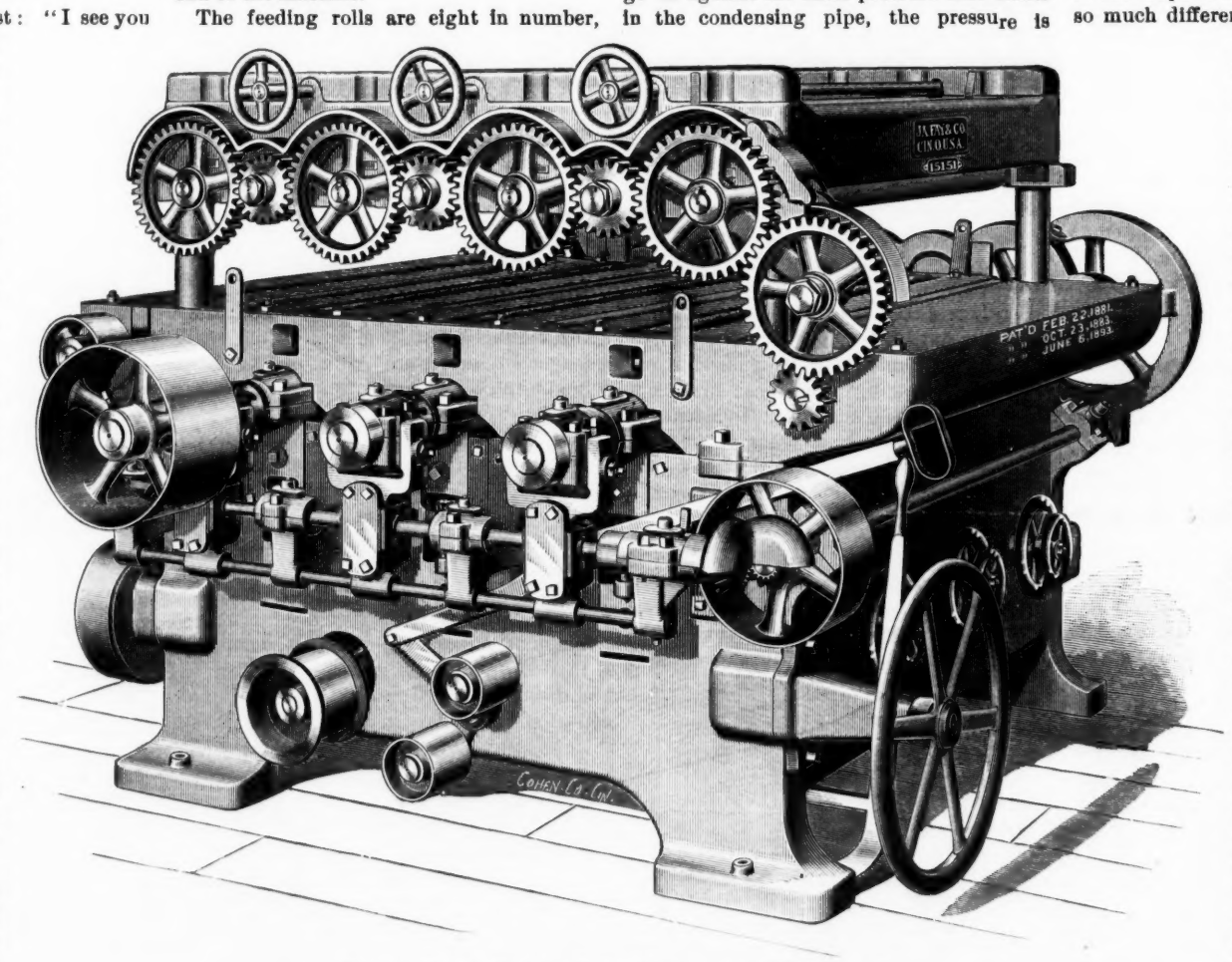
The drums are three in number, made of steel, upon which the sand-paper is placed, and graded according to the work to be done The first drum carries a coarse grade of paper, the second drum a fine grade for smoothing, and the third drum a still finer grade for giving the material the polished surface Each drum has an oscillating or vibrating motion laterally across the material to prevent the formation of lines, which would result if the revolving motion was direct. They are equipped with a device for placing the sand paper about them, and giving it the proper tension in the shortest possible time.

The drum shafts are steel, $2\frac{7}{16}$" in diameter, and revolve in heavy bearings gibbed to the sides, and with adjustments to lift both ends of the drum at once, or either end separately for alignment. The drums can be easily removed by raising the entire roller and bed frame, which opens a space directly over them sufficiently to lift them out and over their bearings. This raising device is operated either automatically by a system of gearing operated by a lever, or, by hand by the large hand wheel, by which the screws at the four corners of the machine are turned, the screws resting on anti friction rollers, giving very easy motion in raising to any height. The adjustment of the drums for the difference in heavier or lighter cutting is done by the movement of the three hand-wheels at the end of the machine.

The feeding rolls are eight in number, four above and four below the platen, driven by a train of heavy expansion gearing, and giving a very powerful feed. They are placed so the material will pass between the upper and lower sets, and open to receive material 8" thick. The lower rollers are placed one on each side of each drum; each roller is located in a separate bed-plate. Each bed-plate can be set to gauge the amount of cut to each drum, or all the bed plates can be set in line, and the drum set to the cut desired above this line.

The upper rolls are mounted in a frame over the corresponding lower rolls. The pressure rolls are three in number, one over each drum to hold the material firmly to them, and are separately adjustable by the hand-wheels shown in front. The feed is governed by a double belt tightener operated by a hand lever.

A brush attachment is provided for cleaning the material as it passes finished from the machine. The countershaft can be placed in any position that may be desirable. The machine is made to work 30", 36", 42", 48", 54", and 60" wide, and is built by J. A. Fay & Co., Cincinnati, Ohio.



Triple Drum Power Feed Sand-papering Machine.

The attempt at using the State prison convicts in the State of New York for road-making is a good deal complicated by the fact that it requires the services of too many guards to watch them. It has not, however, been tried extensively enough to get a fair idea of its value, and further legislation in relation to it has been introduced at Albany. In the end it looks as if a good many prisoners would be so employed, but only within a limited radius of their places of confinement.

Lubricators and Lubrication.

By W. H. Wakeman.

Some men who are in charge of steam plants apparently do not understand the principle which causes their lubricators to discharge their cylinder oil, drop by drop, into the steam pipe, whence it is carried into the steam chest and cylinder, lubricating the valves and piston, reducing friction to a minimum, prolonging the life of the parts, and saving coal. In the opinion of some it is the steam pressure which causes the oil to ascend or descend, as the case may be, through the sight-feed glass, but it should be remembered that as the oil must go in against the same pressure that exists in the condensing pipe, the pressure is equalized, and, as far as this point is concerned, it is the same as if no steam pressure existed there.

Having rebuilt a lubricator some time ago, I set it up on a stand in the engine room, without connecting the pipes to anything. I then filled the body of it with oil, and the condensing pipe and the sight feed glass with pure water. Calling in a friend, we proceeded to open the regulating valve, when the drops began to ascend, just as when the apparatus was attached to the steam pipe in the usual way, and continued to do so as long as the condensing pipe was supplied with water. His surprise was unbounded, but if any one who thinks that it is the steam pressure which causes it to operate, will try the same experiment, he will see his mistake. The oil should be warm in order to produce the same conditions that exist in practice.

The drop of oil descending into the body of the lubricator, usually through a pipe which extends nearly to the bottom of it, causes a drop of oil to be lifted out, and it then passes on to the steam pipe. Now, the drop of water will descend through light or warm oil by its own weight independently of any pressure, but if a pressure in excess of the steam can be brought to bear upon it, then it will descend through heavy or cold oil without trouble. The condensing pipe furnishes this excess of pressure, by providing a column of water, and the pressure is increased directly as the height of the column above the level of the oil.

If we take a piece of brass pipe 10 feet long, and coil it up until the distance from the top of the oil to where it is connected into the steam pipe is 2 feet, we shall have an abundance of water, but the pressure will be that due to a column of water 2 feet high only, which is a trifle less than 1 pound. On the other hand, if we connect the pipe without putting any coil in it, we shall have a pressure which is due to a column of water 10 feet high, providing, of course, that the condensing pipe is kept full of water. It will be a trifle more than this, because the water, which is below the level of the oil, has an excess of weight over that of the oil, but this is so small as to be ignored. From the above it will be seen that if we have a lubricator which feeds the oil in ascending drops, and it is located in a cool place, it will be well to have a high condensing pipe. If the cup has what is known as a steam feed, or, in other words, if the drops of oil descend, it does not make so much difference, as these cups soon become warmed up, thus rendering the oil more limpid, and causing it to feed more readily. The fact that an oil is thick and apparently of a heavy body does not always mean that it has good wearing qualities, for some very thin oils are efficient lubricants.

If a certain brand of oil has been used in a cylinder for several years and for any reason it is desired to use some other kind, the new oil may not give satisfaction at first, but this does not necessarily prove that it is not a good oil.

After having used an inferior grade of oil for a long time, I commenced to use one of the best brands of oil in the market, but there could be no doubt that there was something wrong, as the engine could not be run with it. It was of the automatic, disengaging type and as soon as the valve gear commenced to open the valves, the vibration was so great as to cause them to be released at once, thus shutting off the steam before enough had been admitted to do the work. The remedy was to mix one gallon of the new oil with four of the old, and when the lot was used up, mix another one, using two of the new and three of the old, and so on, until the new oil could be used without trouble.

Before emptying cylinder oil out of the barrel, it is a good plan to nail a piece of mosquito netting, or a fine sieve over the bung-hole, as then all chips, old bungs, etc., will be excluded from the oil tank.

Representative Tracey, of New York, has introduced a bill in Congress which provides that any citizen of the United States, or any corporation under United States laws, nine tenths of the stock of which is owned by American citizens, may buy foreign vessels and have them admitted to American registry, provided bonds are given that equal tonnage shall be built in American shipyards. The bill appears to be the making common to all the privilege given in the instance of the "New York" and "Paris."

It took something over four years vigorous pushing in the courts to settle a little matter of a few railroad ties in which the New York, Susquehanna & Western Railroad was concerned.

LETTERS FROM PRACTICAL MEN.

A Misprint.

Editor American Machinist:

I notice the types make the depth of my worm thread .0330; this is an error, and should be .330, which makes a big difference. Will you please correct this?

HARRY M.

Boiler Inspection Laws.

Editor American Machinist:

It is with a great deal of pleasure that I can get an opportunity to dive into the letters of your varied correspondents and enjoy them. Twenty years ago when living in Chicago many a scalping have I received from fellow engineers who wrote with a sharp stick. I have the pile of Chordal's letters now, and when time permits like to con them all over again and laugh as I used to laugh in younger days.

But, Mr. Editor, in the various comments made concerning boiler explosions, and the need of legislation compelling men employed in handling steam and its appliances to be capable and experienced men, and the necessity of a license for engineers, no one has seemed to think anything about compulsion of the employer that he shall employ an experienced man around the boilers! It is a singular thing that in all States where a license law prevails, so far as I have been able to learn after giving the matter considerable study, there is no law on the statute books that aims to punish the owner who is willfully endangering the lives and property of his neighbors and the men in his employ, by putting a man in his fire-room whose best recommendations are "brawn and muscle and a short clay pipe."

In the financial stringency that we have been passing through, brains have been at a discount—anything to save the almighty dollar—and the competent, skillful engineer has been the first man to suffer in too many instances.

In all States where a license law is being considered, let the responsibility rest on the owner.

It is a burning shame that in every law I have seen, every misdemeanor and fine has been put on the engineer—it is unjust and arbitrary legislation. NORMAN.

As to Corliss Engines.

Editor American Machinist:

At our second monthly meeting I did not get an opportunity to reply to Mr. Holloway and Mr. Cartwright in regard to the Corliss engine.

Mr. Holloway says the Centennial Corliss engine "was a monument in very many ways. That it was not the best kind of an engine for the general user has been proved by its being removed to the Pullman Palace Car Works, and set up as a show, I believe, while other engines are doing the work." Now, Brother Holloway has been misinformed, I am sure. Last August, on a visit to the Fair, I took a day off and went to look at this engine show at Pullman. I found a grand show, and the show engine was also doing work as well. The engineer showed me indicator diagrams taken from one cylinder only (the other cylinder being disconnected for repairs), and it was developing 1,500 horse-power, with a boiler pressure of 70 pounds per square inch; when both cylinders are in use, 30 pounds is all the pressure carried to do all this work. By the above, it will be seen the show is a good one.

Mr. Cartwright's argument is that Corliss engines "need a doctor very often." "A Corliss engine cannot be repaired by any machine shop; it may be done by special machines." I would state that when I carried on a machine shop I did the repairs for over 20 Corliss engines, covering some ten years, and did the repairs with a hammer and chisel, and was quite successful, too. But, as Mr. Sweet remarked, "as to putting the right engine in the right place. There is a right and a wrong place; if not for all, at least for several kinds." For instance, a Corliss engine would make a poor show as a locomotive engine, as has been proven. I have taken cards from Corliss engines after running ten years without repairs, and the steam leakage by the valves was *nil*.

W. BARNET LE VAN.

A Suggestion for a Flying Machine.

Editor American Machinist:

It used to be considered as evidence of light headedness when a person even began to dream of flying machines, but as opinions are now changing, I will run the risk of making one suggestion in this direction.

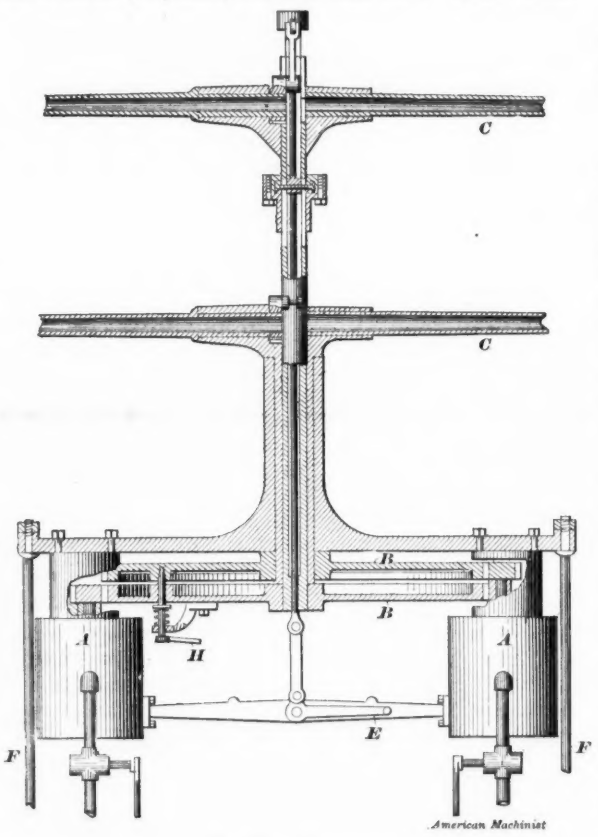
I understand it is pretty well settled among investigators that the necessary power for the weight is now to be had in steam engines.

It has also been quite clearly proven by men's investigations and bird observations that aeroplanes can be made to sustain the load when driven at a suitable speed.

To form an idea of the sustaining power of aeroplanes, consider the pressure of a strong wind on the sails of vessels. A sail driven in a quiet atmosphere at a speed of 30 miles an hour will meet with the same resistance as a sail held stationary with a wind of the same rate of speed blowing against it.

Move the sail 100 or more miles an hour and it will sustain quite a load.

Some suggest pushing the aeroplane by use of aerial propellers, but this calls for a high horizontal motion before the machine can be expected to leave the ground, and also that some very sensitive contrivance be used to guide and keep the machine in balance.



FLYING MACHINE.

To imitate a bird's way of flying would require as perfect a nerve system, which I believe to be difficult with machinery.

Birds are able to make use of the power of the wind—perhaps man can do as well, but he must first learn the simpler things.

The suggestion I have to offer is for a machine to move directly upward to a suitable height, and then use its stored energy for soaring on aeroplanes in the desired direction.

In the drawing inclosed I show enough of the machinery, I think, to make the idea plain to mechanics. *A A* are to represent steam turbines, which are said to be as economical in the use of steam as any engine, and (if so) on account of their small size and weight would be most suitable for such a machine. The boiler is not shown, but should be suspended from the rods *F F*. The attendant can stand on top of the boiler, in a good position to put his foot upon the safety valve in case he wanted to go higher, the sails to be attached to the two sets of arms *C C* like the blades of a propeller. Now, in operation, the turbines through their pinions, the spur gears *B B*, and the hollow shafts, set the sails in motion in opposite directions, so the abutment of one will balance that of the other and so prevent the rest of the contrivance from turning.

It should be borne in mind that the sails should be aeroplanes of large area, only differing from other proposed aeroplane machines in the motion being circular instead of in a straight line. If the machine is properly designed and built, and theories are correct, it should be able to fly straight up, then when a suitable height is reached the turbines can be stopped, the latch pin *H* thrown in to hold the arms *C C* parallel and together, the bell crank lever *E* thrown over so as to bring the sails on each end of the arm at the same angle, and the machine is in shape for horizontal soaring.

The turbines can then be used for steering. During the time of soaring steam can be got up for the next turn at rising, so it will be seen that the power would only be needed in spurts.

About such little matters as absorbing the moisture from the clouds for use in the boiler, and electricity and heat from the air for making steam, also capturing the fowls of the air for food, so as to go around the world four or five times without coming down, I shall make arrangements with Jules Verne.

I don't say this machine can be made to work, but I do ask the question, if not, why not? A MECHANIC.

Providence, R. I.

Gears for Screw-cutting.

Editor American Machinist:

In the AMERICAN MACHINIST of February 1st, Mr. Charles Miller states that in the article by Mr. W. H Croker (issue of November 9, 1893), the thread to be cut on a No. 5 Barnes lathe, in Mr. Croker's example, is 14 threads to inch.

This is a mistake, as Mr. Croker's example was to find the pitch of a worm to fit a 14 diametral pitch gear, which, as Mr. Croker states, is .224".

I think the method of Mr. Croker for finding the change gears for odd pitches of threads a good one.

I have had some experience in finding the change gears for odd pitches of threads on a Prentice lathe, with a compound of 2 to 1, which I will give for the benefit of the readers of the AMERICAN MACHINIST. The Prentice lathe has a lead screw of 6 threads to inch, and change gears 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, and also two gears of 24 and 48 teeth keyed together which run on a separate stud for compounding.

As an example—Required the gears to cut a lead cam, with a pitch of .182" in 110°. Then .182" $\times$ $3\frac{3}{17} = .596'' =$ pitch of thread to be cut or distance from one thread to another. The pitch of lead screw is $\frac{1}{6}$th of an inch = .167.

.596 $\div$ .167 = 3.57 = proportion of gears.

Leaving out the .07 (as it is but a small error which is nearly offset subsequently) we have a proportion of $3\frac{1}{2}$ to 1.

Now the single gears of lathe will not cut a thread as coarse as this, so the compound must be used.

To figure a thread twice as fine as this and use compound would give a correct result.

$3\frac{1}{2} + 2 = 1\frac{3}{4}$, and we find two single gears with a proportion of $1\frac{3}{4}$ to 1.

Multiplying by any number which will bring the $1\frac{3}{4}$ to correspond nearest to the gears which we have, as $36 \times 1\frac{3}{4} = 63$, and $36 \times 1 = 36$, then 63 and 36 by using the compound are the gears required.

We add one tooth to the 63 gear and we have the 64 and 36 change gears.

Adding the tooth to the 63 gear offsets the previous error of .07, nearly.

As another example—Required the gears to cut a lead cam of $\frac{3}{32}$" lead in 180°.

Then in 360° or one pitch of thread would be $\frac{3}{16}$" or distance of one thread to another.

The denominator corresponds to the number of threads and the numerator to the number of inches.

Thus $\frac{3}{16}$ pitch = 16 threads in 3 inches.

The lead screw = $3 \times 6 = 18$ threads in 3 inches.

$2 \times 18 = 36$ driver.

$2 \times 16 = 32$ driven.

By means of the single gears any even number of threads can be cut from 2 to 18 to inch inclusive, and by using the compound a great variety of fractional threads can be cut from 1 up to 36 threads to inch.

J T. G.

[We have to confess that we did not, as we should have done, look up Mr. Croker's article to ascertain just what he did say before publishing Mr. Miller's criticism upon it, but took it for granted the quotation was correct, which was an injustice to Mr. Croker. A good deal of trouble would be avoided if correspondents would always take sufficient pains to assure themselves that they know precisely what has been said by another before criticising him, and then in making quotations they should be accurate and so as to convey the full meaning of the author.—ED.]

Mounting Blue Prints on Cardboard.

Editor American Machinist:

Having noticed an inquiry for a way of mounting blue prints and keeping them from warping, I would like to say that for pasting on the prints, about the best paste I know of is patternmakers' glue, and if the mounts are shellaced on *both* sides they will remain straight. For shellacing use the same kind as for patterns, of course without lamp-black in it. Drying them under a weight will not keep them straight.

J. J. EWING.

Pasting Blue Prints.

Editor American Machinist:

I cannot resist the temptation to tell the inquirer of Question 68 in the AMERICAN MACHINIST of February 8th, that if he will take a good grade of friction paper, such as is used in the manufacture of paper frictions, and paste his blue prints on with the ordinary skill and application which he must be presumed to possess, and when it is dry go to the pattern shop, and apply a neat coat of shellac varnish, such as patternmakers use, over the face of the blue print, leave it set or stand in a dry place for a short time, until thoroughly dry, he will find that it will hardly be possible with ordinary care to heap any abuse on to that blue print which it will not withstand. Good friction paper is impervious to the most severe changes of temperature, and the varnish puts a glaze on the print that is almost equally proof against dampness, probably for the reason that the friction paper can or will not absorb any of its chemical constituents.

Many a time I have picked up blue prints thus treated, which have been left under leaky places in the roof, where the rains which came up during the night have been pouring down for hours directly on to the face of the drawing, wiped it off and dried it, and found it as nice and smooth as ever. I know lots of blue prints thus treated that have been used and stored away alternately for fifteen years, that are as nice and plain to-day as when they were first brought in the shop. W. H.

Pasting Blue Prints on Cardboard.

Editor American Machinist:

About three years ago the problem of pasting blue prints on cardboard was presented to me, and I had about the same difficulties C. H., Decatur, Ill., seems to have. I tried boards of all description, heavy and light, the most expensive trunkboard as well as the cheap strawboard, used mucilage, starch and flour paste, varnished the blue prints before pasting, and the like.

To day I am able to paste as many as may be demanded, all coming out O. K.

The requirements to obtain good results are as follows: The thinnest blue print paper obtainable, strawboard about $\frac{1}{16}''$ thick pasted on one side with cheap manilla paper for the back, flour paste and white shellac. Make the paste thin (mix the flour with cold water to the consistency of cream, and then boil it over), and coat the blue prints on the back rather thin, whence it should be placed on the dry board quickly without any pressure; use a hand brush to straighten the blue prints from all wrinkles, taking particular care not to put the hands upon the freshly pasted blue prints. If the edges of the blue prints do not adhere to the board, which is very essential for their life, lift them off from the board for a few inches, and their whole length, coat them again and brush them down.

It is necessary to start to brush from the middle or center of the blue prints towards their edges, otherwise there is no end of wrinkles. Now, since the blue prints have been coated with paste they are *expanded*, and very likely the blue prints will be convex, which will, while drying, change and become concave. To straighten such concave blue prints we can apply no mechanical power, but must do it by varnishing. I have found that the only way to do it is by varnishing the back of the pasted blue prints with diluted shellac first, let it dry perfectly, and give a coat of very much diluted varnish—about one part of commercial fluid shellac to six parts of alcohol—on the face of blue print. The shellac so deposited will be of little value as a varnish—the main object is to expand both blue print and board until it is convex (a little) again; while the alcohol evaporates, the shellac sets and keeps the blue prints perfectly flat. If this result is not obtained the first time, the shellac was not diluted enough, and another coat must be given. When the blue prints are flat a coat of varnish may be given to both sides, and when dry they are ready for the shop. Avoid giving too heavy a coat of paste, whatever it may be, or else it will penetrate the blue print paper (whether thick or thin) and render it white. The same thing will happen if you put your hands on the fresh pasted blue print, except that it will show the contours of your fingers and palm in white. I get the strawboard pasted with manilla paper by the dealer, and it serves as finish to the whole as well as aids in straightening the finished work. A few trials and a little patience will soon teach any one how to manipulate this. I always have had success with any boy to do the work. Whether this method of maintaining blue prints is best is a matter of opinion, and if I again should have anything to do with it I would consider it again.

E. Lawrenz.

Holes in Castings.

Editor American Machinist:

I would suggest that Mr. Drake have a sample of one of his defective castings analyzed for a determination of silicon. I should say for that kind of work the casting should contain about 2.75 per cent. silicon. If the analysis of the iron in the yard is known there should be an average of 3 per cent. silicon before melting, as about .25 per cent. is lost in the melting.

If the iron is melted with coke for the bed I should say wait as late as possible in the heat before pouring the boilers, as the first iron will contain more sulphur than the last, owing to the greater percentage of fuel to iron used on the bed. This would also be true to some extent if coal is used, but I am inclined to think good coal better and having less sulphur than coke, and that there would be more difference between the first and last iron with coke than with coal.

I don't think I ever saw a car of pig-iron of any brand or number but that some of the bars would have holes in them, which is due to the gas escaping when the pig is poured, but it is my opinion that the difficulty is not communicated to the iron. Any cast-iron poured into an open mold made as pig molds are made, would be likely to show the same thing. A. K. Beckwith.

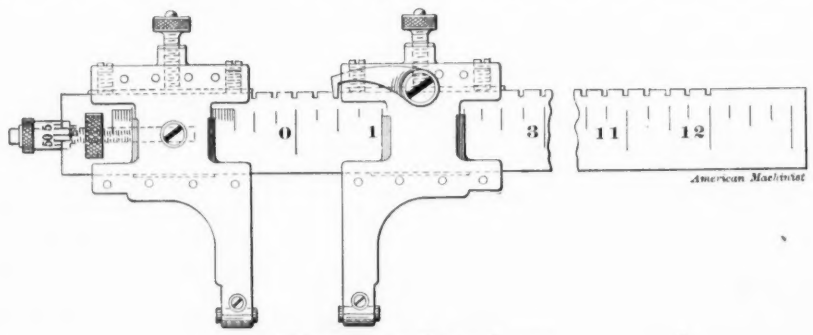
A Micrometer Beam Gauge.

Editor American Machinist:

Inclosed is a blue print of a 12-inch beam gauge which I constructed two years ago. The general features of the gauge I think appear clearly illustrated by the print. The beam is of tool steel $\frac{5}{16}''$x1$''$x16$''$. Upon it are the two movable heads, each provided in its projection or finger with a steel plug hardened and finished to exactly $\frac{1}{2}$ inch, so that when joined together they measure 1 inch outside; and when they are placed 1 inch apart they then measure 2 inches (outside ends), and so on for 12 inches; you will observe that, corresponding to the graduation, each head is cut away to 1 inch with bevel edges on each side for correct reading of size set on; agreeing with the graduations on the notches cut in top of bar into which fits the latch pivoted to the right-hand head. These notches are located just $\frac{1}{4}$ inch apart. In the print the gauge is set at 1 inch. The fastening of the heads by means of the thumb-screws on top is no new device on tools of this kind.

The right-hand head is thus located exactly on any quarter inch in the 12-inches. The left-hand head is provided with a micrometer screw and nut to locate its position in thousandths of an inch—over or under, as the case may require.

To illustrate, suppose we want 4.128 inches; we first set the right-hand head at 4 inches; we next set the left hand head .128 inch away from the zero line: $= 4'' + .128''$. Again, suppose we want 3.872 inches; then we set the right hand head at 4 inches, and next we move the left hand head at



A Micrometer Beam Gauge.

.128 inch towards the right hand head from zero line:

$$4'' - .128'' = 3\ 872''.$$

The knurled nut occupying the mortise in left end of beam, through which the micrometer screw passes, is for the two fold purpose of moving the head, and, when micrometer nut is set, to gently take up all backlash previous to finally fastening head by set screw.

The end sought after was to construct a 12 inch beam gauge whose measurements in any part of the 12 inches would compare favorably with the best Brown & Sharpe 1-inch micrometer measurements; there are some points in its construction and operation which are absolutely necessary to observe in order to reach the desired result. The construction of the tool, the possession and use of it demonstrate the correctness of some opinions previously held, and at the same time corrected others.

The use of the gauge is not as limited as an ordinary micrometer, but is equally as accurate for both internal and external measurements.

Either inside or outside calipers or gauges can be set accurately by the gauge.

It is a valuable tool for sizing of gear blanks or work of that kind (*i. e.*, obtaining measurements in $\frac{1}{1000}$ part of inches by setting calipers to the hardened plugs) insuring very much greater accuracy than by the use of an ordinary scale.

The beam is not annealed steel, but unannealed; which gives it two advantages: *first*, greater rigidness so that there is less liability to deflection from any cause; *second*, less liable to be affected (in length) by varying temperature.

The moving heads are constructed so as to fit the beam accurately and unvarying, whether set or loosened, and yet move very easily, which is very necessary to obtain uniform measurements. I find it a valuable addition to my tools.

Francis W. Clough.

Springfield, Mass.

Draftsmen and Shopmen.

Editor American Machinist:

Draftsmen, as a class, are not heard from very much in your columns, and they are the losers for it. If they would—some will say "could"—take part in the discussions, etc, which take place through the medium of your paper, they would probably help to bring about more harmonious relations between the drafting-room and the no more practical, but more material branches of the business. It is to be regretted that feelings indicated by the remarks of "Easy Way" and "The Tramp" are too prevalent in our shops. It is really the old war between theory and practice, which in every battle only demonstrates the frailties of all of us, for who can isolate the one from the other? The variance seems likely to continue until every man knows everything there is to be known. As a product of the shop, but now spending my time at the drawing-board, I have had some little experience on both sides of the question.

No one with common sense will dispute the utility of a drawing which fulfills its mission, and that is simply to arrange and state in a "lineal" language, and as plainly as possible, certain facts, which will enable the patternmaker, the molder and blacksmith, and the machinist to do their part of the work with the smallest possible expenditure of time in finding out what to do. If the drawing does not accomplish this by reason of its unnecessary complexity it must be a hindrance rather than a help. With the modern greater division of labor, drawings have become more and more necessary, and the time has passed when it was possible to partly design your machinery while you were building it. It is more convenient, and much cheaper to experiment on paper in the drawing-room, than with materials in the shop, and no shop, however small its business, can well afford to be without some one to do this experimenting, even if his deductions be expressed only in freehand sketches. A good example of this has recently come under my notice, in which a foreman wasted many dollars on patterns made under his direction, which were thrown away as unsuitable, when a little time spent at the drawing-board would have saved it all.

As to the mistakes made on drawings, it may be said that a good draftsman will at least make as few as a good machinist.

Much trouble has arisen from the fact that many machinists, including their foremen, in some instances, are quite unable to read a drawing, and are inclined rather to go by their old cut and-try methods. They quite naturally feel more sure of a thing when they have the solid material before them than when it is simply represented by lines. It is a curious fact that the loudest cry has always come from the machine shop, and more so, when it is reflected that the materials come to that department already in a close approximation to their proper shape and size.

If no drawing is furnished the patternmaker he will immediately set about making one of some sort for his own guidance, while the machinist too often feels perfectly confident without such help, and the scrap heap is the gainer. Sometimes he is successful, and in proportion to his success he despises the use of drawings.

On the other hand, it goes without saying, that drawings will not insure perfection in shape, fit, etc., for there are many things which it would be impracticable to put on a drawing. These are left to the judgment of the workman. There must also be some final cutting and trying, and therein is the weak point of systems for the interchangeability of parts. So long as humanity remains human, there will exist the necessity of this final fitting, and no amount of drawings, templates or micrometers are likely to remove it entirely.

A good stock of common sense, and a reasonable amount of forbearance, are indispensable to harmony in the different departments of the machine business, as of every other business. Cogs.

Strength of Beams.

Editor American Machinist:

I notice Mr. Mackintosh's letter in the current issue of the American Machinist, and must say that Mr. Mackintosh appears to have read my letter in the same light in which he has read his text-books, and with a like result.

In the fifth paragraph of his article, Mr. M. "admits" that the neutral axis would pass through the center of gravity "for a material having the same *strength* in compression as in tension." My first paragraph in correction of this, was to the effect that the neutral axis passes through the center of gravity when the *elasticities* in tension and compression are equal *independent of the relative strengths.*

For "strengths" in Mr. Mackintosh's article read "elasticities"; this is my correction—surely this is clear enough. I think Mr. Mackintosh sees it, but wishes to "pass it over lightly" without admitting the correction.

My second paragraph was, perhaps, not as clear as it ought to have been. I meant to say that Mr. Mackintosh was led into error by discarding the material of his beam down to a single layer of fibers, as it seemed to me that perhaps he would not have lost track of the neutral axis if he had kept a material connection between the tension and compression members of his beam. It is his misconception of the meaning of the term "neutral axis" that is at the root of his quarrel with the formula under discussion.

I should like to draw his attention to the fifth paragraph of my letter, and ask him to compare my definition with his own. If he does not see the difference, or if he requires some other authority for my definition, I will try to oblige him.

I do not think that Mr. Mackintosh has any excuse for misunderstanding my third paragraph. In order to deal with definite areas for simplicity, I retained the original areas of the flanges, viz., 1 and 4.5 square inches respectively, but spreading them out into a single layer so as to suit Mr. Mackintosh's argument. Now, I did not *make* the flanges equal to each other as Mr. Mackintosh appears to understand, but I "kept" them "the same" (as they were before they were spread out, of course) and therefore I was quite in order in my application of the formula.

I am inclined to think that a little more attention to the "argument over *terms*" would have been of service to Mr. Mackintosh. If he will use the term "neutral axis," as it is intended to be used, and try his *disproof* again, he will find that he has no case.

Mr. Mackintosh's reminder in paragraph six of his letter, "reminds" me of the parson who preached to his congregation that they should do as he *said* and not as he *did*. I should like to see Mr. M. show the fallacy of the reasoning behind the formula which he criticised in his article.

Now, as to Mr. Mackintosh's numbered paragraphs, 1 to 4 are all right. No. 5 is in accordance with the result obtained in the third paragraph of my previous letter.

As to No. 6, why "must" the neutral axis be "at a point which will give equal moments for each flange?" Perhaps Mr. Mackintosh will demonstrate this, but I must ask him if he attempts to do so to first define the term "neutral axis," and then we may have a chance of understanding each other.

I may say that I have known Unwin's "Elements of Machine Design" for a good many years, and always have a copy by me for reference. I have looked up the paragraph referred to by Mr. Mackintosh only to find information of old acquaintance. Might I in turn call Mr. Mackintosh's attention to paragraph 27 (in the sixth edition) subject, "Resistance to Bending," he will there find a term defined which has very often been written in this correspondence.

Toronto, Ont. F. GARSIDE.

Strength of Beams.

Editor American Machinist:

In your issue of January 4, 1894, is an article offering objections to the theory that the neutral axis of a beam necessarily accords with its center of gravity. Cast-iron is cited as a substance that should be an exception to the old theory on the ground that it has 4.5 times the ultimate strength in compression that it has in tension. To illustrate the proposition, a beam is taken consisting of an upper flange of 1 square inch area and a lower flange of 4.5 square inch area connected by a web that may be neglected.

Permit me to start out in this justification of the old theory, by using some of the words of the article in question.

"Assume for the moment that the beam is reduced by the removal of all but the extreme upper and lower layers of fibers, leaving only a single layer in each flange. These two will react against each other, and the reactions will, of course, be equal. That they are capable of equal resistance will be evident when it is considered that there are 4.5 times as many fibers in the lower (which is supposed in tension) as in the upper (which is in compression)".

Now, let us suppose the beam, as assumed, so loaded that 1,000 pounds, for example, is resisted by compression in the upper flange. Then 1,000 pounds must also be resisted by tension in the lower flange; and there being 4.5 times as many fibers in the lower as in the upper flange, there will be but $\frac{1}{4.5}$ as much stress in each lower as in each upper fiber.

Applying the principle upon which the old beam formulæ are based, viz., that the stress in a fiber is proportional to the distance of that fiber from the neutral line, it will be seen that the neutral line must be 4.5 as far from the upper as from the lower flange. This, of course, locates it in the center of gravity, as the flanges are in the proportion of 4.5 to 1.

The only thing that tends to make this incorrect is the assumption that the modulus of elasticity is not a constant quantity. This supposition in itself immediately throws out all logical use of the moment of inertia as a factor.

Experimental evidence, however, shows that within the elastic limit of a material—which is far within any safe working limits—the modulus of elasticity is a constant quantity, being the same for tension as for compression. In many substances the limits of elasticity are reached much sooner in one direction than in the other, but none are able to resist tension like steel—while yielding to compression like rubber.

WM. R. KALES.

The cable announces that a new English torpedo destroyer called the "Hornet" has shown, upon her trial run, a speed of 28 knots an hour, and her builders claim she is the fastest vessel in the world.

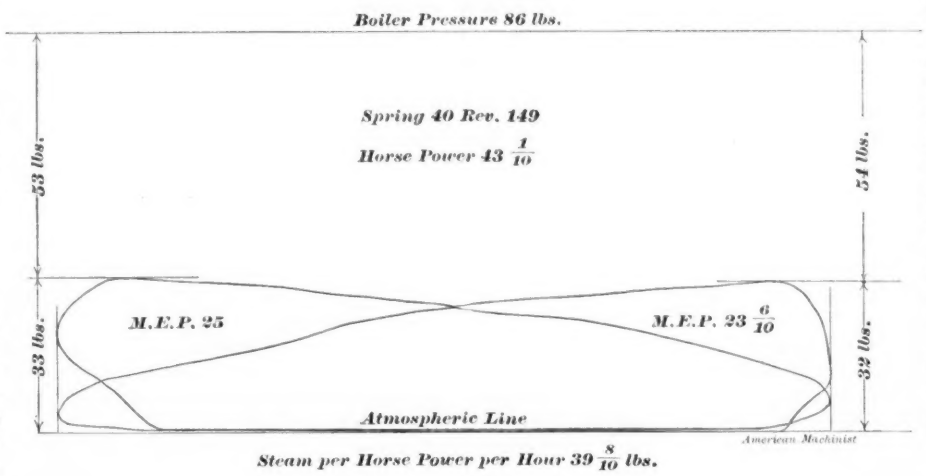
It is said that since 1860 the United States government has given 3,000,000,000 acres of land to railroads, which at five dollars an acre would a good deal more than pay for all the railroads in the country.

An Instance of Steam Economy.

BY EDWARD J. WILLIS, M. E.

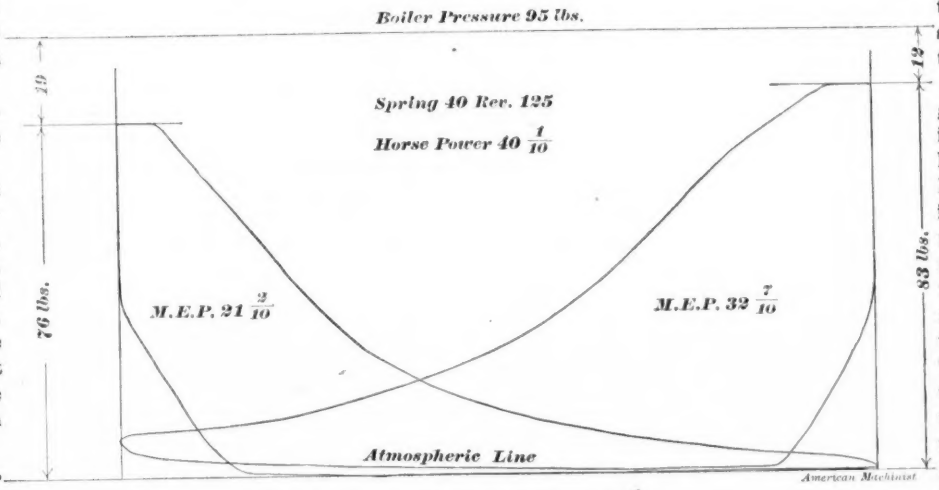
A manufacturing company purchased a few years since an engine 13 inches diameter of cylinder, and 18-inch stroke. The makers guaranteed the engine to deliver 50 horse-power when running at about one hundred and fifty revolutions. It appeared, however, unable to run the machinery of the establishment, and the writer was called in to examine the case. The makers claimed, as is usual, that the engine was overloaded, and were required to prove this by the use of an indicator. After some delays with hot brasses and melted babbitt they produced card No. 1, showing $43\frac{1}{10}$ horse-power. This they stated was near enough to 50 horse-power to have reason to believe that the engine would be able to comply with the contract. This card is worthy of examination, as it was taken by the builders of the engine, and represents what is not unusual in the lower grades of plain slide-valve, throttle governed engines. It is to be noted that out of the 86 pounds boiler pressure, only 33 pounds reached the piston; 56 pounds being held back by the governor. The consumption of steam per horse-power per hour by card is 40 pounds, and allowing the usual 33 per cent. for cylinder condensation we would have about fifty-three pounds actually used by the engine per horse-power per hour. As the steam was probably considerably superheated by the excessive throttling, this figure is probably a full one. It is easy to say what the builders should have done with the valves, etc., and the truth to write they certainly did all they could think of. For somewhat lengthy reasons, hardly interesting to the average reader, the writer advised an amicable adjustment of the financial part of the matter, and the prompt removal of the engine. This was done, and in its place was put an engine of exactly the same size, but of different design.

Card No. 1



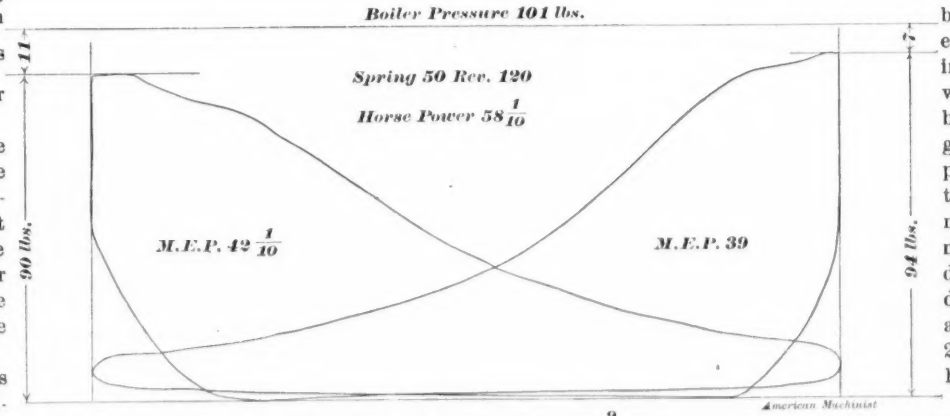
Steam per Horse Power per Hour 39 8/10 lbs.

Card No. 2



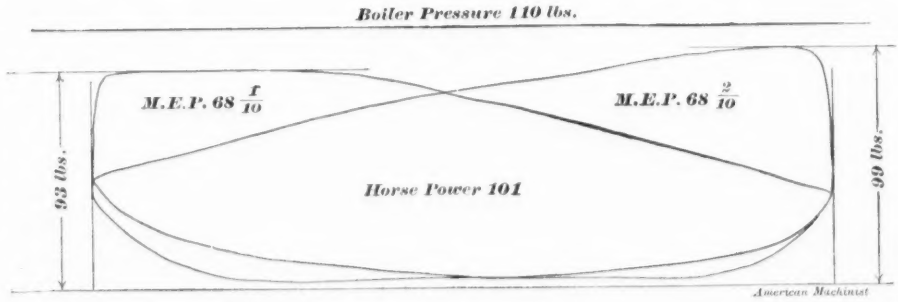
Steam per Horse Power per Hour 22 8/10 lbs.

Card No. 3



Steam per Horse Power per Hour 24 9/10 lbs.

Card No. 4



Spring 80 Rev. 122

Steam per Horse Power per Hour 34 lbs.

The further indicator history of this engine is probably interesting on account of its being a good example of how far overloading may be carried without its being known. The business of the company so increased that new machinery was added from time to time. One morning the engineer reported that he could not start up with his former boiler pressure, and had found it necessary in order to start to raise the boiler pressure to about 110 pounds. The writer found on applying the indicator that the engine was carrying a load of more than twice its guaranteed horse-power. The result is given in card No. 4 where the horse-power is 101 and the mean effective pressure nearly two-thirds the boiler pressure. While it was known that the engine was doing a good deal of work its load was by no means suspected. Except that the belts had to be laced much tighter, and the extra call for steam necessitated heavy firing, there was no indication of anything wrong. This state of affairs was not, as may be supposed, a temporary one, but the engine carried this load of about 100 horse-power night and day for six months, and the only reason why it is not carrying it now is that a still further introduction of machinery necessitated the putting in of a duplicate engine and the present load is divided between them. Their cards are about such as No. 3, say 58 horse-power and 25 pounds of steam per horse-power per hour.

In plants where a strictly constant speed is not necessary and the load not subject to sudden and considerable variations (as is usually the case in ordinary mill work) there is every inducement to put in an engine of this class with an adjustable cut-off. It is a very inexpensive engine, and being self-contained, is cheaply established, and, as shown, is capable, with moderately intelligent handling, of good steam economy.

The Mason Regulator Co., Boston, Mass., show evident intention of awakening new interest in the rather ancient but altogether interesting game of dominoes. At least they send us a set, and say they will send a similar set to any one who will remit 12 cents to pay for boxing and postage.

"Jim, wot is steam, anyhow?"

"It's a sort o' waporous sweat wot the millions of hanimalcula wot's in the water throws off in their hanguish at being scalded to death!"

"Wot a gilly I am! I might ha' knowed as much."—*Life.*

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
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FRED J. MILLER, }

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☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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$3.00 a year in advance, postage prepaid, in the United States, Canada, and Mexico.
$4.00 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
DEALERS SUPPLIED BY

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The American News Company, New York, N. Y.
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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 21 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, MARCH 15, 1894.

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Rapid Transit for New York.

The discussion of rapid transit for New York has lately assumed another aspect by the endorsement given to what is known as ex-Mayor Hewitt's plan by the New York Chamber of Commerce. Mr. Hewitt's plan is not an engineering plan, but a financial plan by which a private company would build the road under a contract with the city, and would then operate it under a definite lease, terminating upon a certain future date, at which time it would be again leased either to the company offering to pay most to the city at a certain fixed fare, or to the one offering to run the road at the lowest fares. By this plan the city's ability to sell bonds at lower rates of interest than any private corporation could obtain would be taken advantage of, while at the same time the actual work of construction and operation would be kept entirely out of the hands of the politicians, and, instead, would be carried on by a private corporation or contractor upon strictly business principles, while at the same time the terms of the lease could be such as would effectually protect the public from the outrageous impositions now put upon them by the elevated roads.

The "business of politics" has, however, we fear, been so developed in the State, and especially in the city, of New York, that it will be found impossible to secure the necessary legislation to carry on the work. It is about as certain as anything can be that any scheme for building and operating a rapid transit road in the city, which will shut out every chance for the lining of politicians' pockets, will have to contend against the active, and, we are bound to say, skillful opposition of the owners of those pockets.

It is very desirable, from all points of view, that this opposition should be overcome, and that the road should be constructed upon terms which would be fair for the people who must use them and, in the final analysis, pay for them, and we shall hope for the ultimate success of such a plan, though we must confess that our hope is not so strong as it might be.

Steam Pipe Failures.

We had hoped by this time to have received some reliable information regarding the frightful "Brandenburg" disaster, by which nearly fifty men lost their lives aboard a German war vessel. There is little doubt but that a steam pipe burst, and, of course, we know in a general way that the pipe was not sufficiently strong, but such knowledge is insufficient for the prevention of similar accidents, because, unless we can know what specific forces may possibly act to cause rupture of such a pipe, and what the possible defects of such a pipe may be, there is no way of avoiding the trouble. A good many copper steam pipes have burst within the past few years aboard vessels—pipes that, according to all the calculations that could be applied to them, should have been absolutely safe; that they failed shows that there is some important point about copper steam pipes for marine service that is unknown, and so far seems almost past finding out. It may easily be that some unknown, and, therefore, unprovided-for force is brought to bear upon them that would cause their failure, almost irrespective of their thickness; but still, until more is known about this, it would seem as though the usual supposed factor of strength in such pipes ought to be doubled, or even trebled, and, if need be, again doubled until such accidents cease.

One of the strongest arguments to be found in favor of the adoption of electric or cable roads in cities, rather than those operated by horses, has been prominently brought out in connection with the efforts of a public-spirited society in New York, which is making an effort to somewhat abate the stable nuisance within the city. This society is looking after sanitary matters in the city, and is composed of ladies. It has been found that city stables are a constant menace to the health of those who live in the vicinity of them, statistics and observations of physicians clearly proving this. One way of lessening the evil is by requiring all stable refuse to be baled or compressed in barrels as fast as it accumulates. In attempting to get a law passed requiring this, opposition to it is manifested, not by individual horse owners, truckmen, etc., but by a wealthy and powerful horse railway company controlled by the Vanderbilts, and which keeps hundreds of horses in a single stable, where, it seems, the owners want the privilege of continuing to pollute the air and breed typhoid fever, diphtheria, etc.

Roads which derive their motive power from steam engines, not only are not open to the objection of maintaining large stables, but they also allow streets to be kept much cleaner, and it is to be hoped that the day of the horse or the mule, as a motive power for street railways, is nearly over.

We have many inquiries from machinery men as to the standing and reputation of different European houses who have ordered machines and machinery without remitting or giving references. There is in this country, as in every other, a desire on the part of manufacturers to build up a foreign trade, and this has led unprincipled men in some European countries to use this desire to the end of getting goods with no intention of paying for them. We have no special means of satisfactorily answering the inquiries above referred to, and no other advice to offer manufacturers and others who receive orders from abroad from unknown parties, than to insist upon satisfactory references—or the cash—before parting with their goods.

The rotary steam engine appears to have a fascination for the inventor, but he has generally found his efforts exceedingly fruitless. There is little wonder that men have worked and do work on schemes for a satisfactory rotary engine, because on the face of the matter, the stopping and starting of the piston of a reciprocating engine twice during each revolution of the revolving parts looks like an undesirable thing to do, and to the votaries of the rotary engine it appears to cost a good deal to do it. But most engineers know better than this—or at least think they do—and that this stopping and starting gives just the required opportunity for distributing the steam in the best possible manner, and without the necessity for the equivalent of removing a cylinder head for admission and exhaust.

But because the rotary engine has not yet worked its way to the front, it would be unwise to dogmatically assert that it never will do so. Although we believe Watt built at least one rotary engine, he never gave it the attention he gave the reciprocating engine. Some one may—possibly—devise means for getting rid of the undue internal friction, at the same time packing the piston satisfactorily, and providing for steam distribution according to modern ideas. At any rate, it is about as certain as anything can be that men will never cease trying to do so as long as the steam engine is used.

Literary Notes.

ARITHMETIC OF MAGNETISM AND ELECTRICITY. By John T. Morrow, M. E., and Thorburn Reid, M. E., Associate Members American Institute of Electrical Engineers.

This is an exceedingly useful, instructive and valuable work, and when studied in connection with elementary text-books treating on magnetism and electricity, will aid practical men and students to grasp the subject in a clearer light and obtain more satisfactory conceptions of the underlying principles of construction and designing electro-magnetic machinery than could otherwise be obtained. The authors have kept rigidly within the scope indicated by the title, and have simply given rules of electricity and magnetism with numerical examples of each so as to show their practical application. There has been no attempt at explanation of the phenomena involved and no deduction of the rules given, although in some cases some of the more obvious deductions from the rules have been indicated. The general laws of electric circuits are first taken up and developed at length. This is followed by a chapter on batteries, after which the general subject of magnetism is treated. Finally, the application of the laws in the design of electro-magnetic machinery is worked out, both for direct and alternating currents. An appendix on the electric railway is added. We can recommend this book as one of the best of its kind. It is published by Bubier Publishing Co., Lynn, Mass. Price, $1.00.

We have from the publishers, The Bancroft Company, of Chicago, Ill., Nos. 8 and 9 of "The Book of the Fair." These numbers are largely devoted to machinery, and the large pages of the book enable correspondingly large cuts to be used, which, from the fine quality of the paper, and the good workmanship, show to excellent advantage. For example, the largest engine on exhibition—the Allis—is represented by a picture nine and one half by eleven and one-half inches, and other machines and machinery on a correspondingly large scale, several of the engravings being full page. The "Entrance to Machinery Hall" is a remarkably fine picture, as well as the view of the central aisle in that building. But amongst so many meritorious views, it seems hardly fair to select any as best. It is difficult to say who will be most interested in turning over the pages of the "Book"—those who did not visit the Fair, and who find portrayed the principal features of interest, or those who did visit it, and see again these familiar features. As we have previously intimated, the paper is of a superior quality; the type is large and distinct, making it a pleasure to read the text.

The fourteenth volume of "Transactions of the Society of Mechanical Engineers" has reached the proportion of a book of 1,461 closely printed pages. Comparing this with the early editions of the transactions of the society, one is struck with the wonderful growth of the institution, which has all the way through been managed with rare good judgment.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(122) W. L., Baltimore, Md., writes: Please give me a receipt for making blue prints, and white and black prints; also how to apply the solution. *A.*—See answer to Question 120, March 8th, current volume.

(123) J. W. G., Boston, Mass., writes: Kindly advise me which is the best mechanical dictionary and the price of the same. *A.*—There are several good mechanical dictionaries, among which are the Appletons' Cyclopedia of Applied Mechanics, price $15; Knight's American Mechanical Dictionary, price $27; Spon's Dictionary of Engineering; civil, mechanical, military and naval, with technical terms in French, German, Italian and Spanish, price $55. You must decide for yourself as to which of these is the best.

(123) H. P. K., Freeport, Ill., writes: Please give me a process for enameling or japanning small articles, such as hooks and eyes or buttons in large quantities. *A.*—The process of enameling and that of japanning are different processes; both require skillful manipulation which can only be obtained by long practice. We have had no experience in this class of work, and cannot give you the best method for the desired results. Our advice is to engage a person who is thoroughly familiar with this kind of work.

(124) H. S., Falls City, Neb., writes: Please inform me of a school where I can

learn electrical engineering. *A.*—Write to the University of Nebraska, Lincoln, Neb. 2. Please name some journal or other literature treating on electricity. *A.*—"The Elements of Dynamic Electricity and Magnetism," by P. Atkinson, is a good book. "Magnetism and Electricity," by S. P. Thompson, is a good book for beginners. Your newsdealer will probably have all the journals treating on electricity. We prefer to have you make your own selection.

(125) T. F., Montreal, Canada, writes: Please inform me what will take printed matter off the paper without spoiling its looks. I have tried an ink eraser, but it rubbed a hole in the paper. *A.*—Place the paper on a thick pad of white blotting paper. The ink may then be removed by applying sulphuric ether with cotton wool, gently rubbing the surface of the paper from which the ink is to be removed, then apply white blotting paper to absorb the color. Repeat this operation, using fresh ether each time until the ink is removed. This should be done in a dark place Pure benzine and oil of turpentine will also dissolve printer's ink.

(126) J. W., Boston, Mass., writes: Please inform me where I can obtain a divining or mineral rod for locating mineral veins or deposits. I would like to get one, and have tried in vain in this city. *A.*—It is doubtful whether you can buy one. It is usually made of hazel or of apple or some other fruit tree, tied together at the top with thread, or of a naturally forked branch, and is grasped by both hands in such a way that it moves when attracted by the sought-for deposit. This method of searching for ore or water has been in use for centuries but its efficacy is now rarely credited by intelligent persons. It requires experienced miners to locate the ore.

(127) J. F., Hamilton, Canada, writes: Please give me a formula for computing the amount of clearance that a die should have, or, in other words, the difference in size between die and punch in proportion to the thickness of the metal. I have principally to deal with zinc, tin and thin sheet metal. *A.*—The general rule is to make the diameter of die hole equal to the diameter of the punch, plus $\frac{2}{10}$ the thickness of the plate. Or, in symbols $D = d \times .2\,t$, in which D = diameter of die hole, d = diameter of punch, and t = thickness of plate. For very thick plates some mechanics prefer to make the die hole a little smaller than called for by the above rule. 2 Please give name of a book which treats on die sinking? *A.*—The literature on this subject is scarce; we do not know of a book treating on this subject that we would care to recommend.

(128) C. H. B., Cleveland, O., asks: What should be the proportions for a derrick jib inclined at an angle of 30 degrees from the horizontal hinged at the heel, rope running over the pulley at out end and direct to hoisting drum, to be made of two channel bars, 6 inches apart at toe and 8 feet at heel; length, 58 feet; thrust, 30½ tons; bars braced laterally. What should be the proportions using truss rods above and below, and what should be the size of rods and length of struts? What should be the proportions for a jib built up of plates and angle-irons, making it larger at the center? *A.*—We always take pleasure in answering questions which will assist our readers in designing machinery, but when we are asked to design a whole machine, we must decline, as life is too short to do so and run a newspaper besides. Work of this kind should be given to an experienced mechanical engineer.

(129) X. Y. Z., Three Rivers, Mich., writes: A. works on a Prentiss bench vise and says the jaws are chilled. B. says they are not chilled—they are faced with steel plates which are placed in the mold and the cast-iron run to it. The plates are first prepared with a compound or solution of some kind that causes the two metals to unite. If this is so, please explain to A. what solution or compound will cause steel and cast-iron to unite solidly as one piece, also method of preparing the plates. *A.*—These vise jaws have steel facings, and in this respect B. is correct. But there is no solution used in preparing the plates—these and the cast-iron are united by the process called "burning." The steel plates are placed in the mold, the metal is allowed to flow through the mold, touching the plates until they are heated nearly to a fusion point in order to make a weld, after which the cast-iron unites to the steel.

(130) W. H., Milwaukee, Wis., writes: Please give a rule for finding the speed at which a fly-wheel will burst. *A.*—Divide the ultimate tensile strength per square inch of the iron by .1, find the square root of the product; the result will be the velocity of the center of rim in feet per second. Or, in symbols, we have:

$$\sqrt{\frac{s}{.1}} = v;$$

in which s = ultimate tensile strength per square inch of cast iron, and v = velocity of the center of the rim in feet per second In the cases of heavy masses like fly-wheel rims, the metal in which has not been decarbonized at all by remelting, the ultimate tensile strength per square inch should not be assumed to be greater than 10,000 pounds. Under these conditions the velocity of the rim to burst the wheel will be:

$$\sqrt{\frac{10,000}{.1}} = 316 \text{ feet per second,}$$

or $316 \times 60 = 18,960$ feet per minute. For safety in practice, the velocity should not exceed one third of the above.

(131) O. A. K., Chicago, Ill., writes: I have two large cast iron gears, side by side, driver and driven, on the same shaft, and the bearings of the frame flush up against the sides of the gears. What is the best practice for keying them to the shaft and keeping the shaft from sliding out of place? *A.*—That depends on the general design of the machine and bearings. If the bearings have caps so that the shaft with the wheels can be laid into them, we should make the wheel fit of the shaft greater in diameter than the journals, and then key the wheels to the shaft in the ordinary way. The same method can be used when the bearings are solid, but in this case one of the bearings must be loose on the frame so that it may be removed when the shaft and wheels are to be put in place. If the bearings are solid and both cast to the frame, you may be compelled to use a key and set screws, or set screws without a key. We cannot give any positive advice without knowing more of the general design of the machine. A good draftsman will take all the conditions into consideration and indicate on his drawings the best method of fastening the wheels.

(132) L. N., Beloit, Wis., asks: Which cylinder in a compound engine should have the most lead? *A.*—The amount of lead given to the valves is generally decided arbitrarily, and according to judgment or prejudice. The lead also depends to some extent on the design of valves, or the difference between the design of the high and low pressure valves. On general principles, we should give the same lead to both valves. 2. Which is the proper way to determine the right and left-hand cylinder of a two-cylinder engine? *A.*—When standing at the cylinder end of the engine, and looking towards the crank shaft, the one on the right will be the right hand cylinder. 3 Which is the proper way to compute the horse-power of a single cylinder engine, and one with two cylinders, the steam pressure, revolutions, and size of cylinders being given? *A.*—We presume you refer to single expansion engines. The rule for computing the indicated horse-power of single cylinder engines is given in our issue of March 30, 1893, in answer to Question 156. For an engine with two cylinders, find the horse-power of one cylinder by the rule referred to, and multiply this power by 2; the result will be the horse power for both cylinders.

(133) J. W. H., Cleveland, O., writes: Please furnish me with a receipt for chilling common machinery iron. *A.*—The surface of a casting can, in most cases, be chilled when cast by having iron to form the mold instead of sand; in short, the article should be cast in a chill which is invariably made of cast-iron. Nearly all grades of cast iron can be chilled to greater or lesser extent, but for good work a special quality of iron should be selected. Iron for making chilled castings should be strong, as chilling impairs its strength. An iron that contracts very little in cooling is of the greatest importance in keeping chilled castings from checking or cracking. The depth of the chill in a casting cannot safely be determined by any other means than actual previous tests of the mixture to be used, and is to some extent dependent on the bulk of metal contained in the chill. If you refer to hardening the surfaces of castings after they have been taken out of the foundry, the following method is sometimes employed: The castings are heated to a cherry red and dipped into a liquid made as follows: Soft water, 10 gallons; salt, 1 peck; oil of vitriol, ½ pint; saltpeter, ½ pound; prussiate of potash, ¼ pound; cyanide of potash, ½ pound. If a very hard surface is required repeat the process.

(134) W. G. S., Montville, N. J., writes: Please inform me of the best way of making a spigot joint on pipes 16, 12 and 8 inches in diameter. *A.*—These joints are made with Calking material and lead. The calking consists of about 1 to 2 inches in depth of well rammed, untarred gasket or rope yarn; above which is poured melted lead, confined from spreading by means of clay plastered around the joint. The lead is afterwards compacted by a calking hammer. The lead is poured through a hole left in the clay on the upper side of the pipe. In the large pipes two additional holes are left in the clay, one at each side of the pipe, and the lead is first poured into the side holes by two men at once, one man pouring into each side hole until the joint is half full. The side holes are then stopped, and, after the lead already poured has hardened, the two men finish the pouring by means of the top hole. This course is necessary, because the great weight of melted lead in the entire large joint would press away the clay at the lower side of the joint, and thus escape. Precautions should be taken against the freezing of the moisture of the clay in cold weather, and to render it to be too hard to be used. It is also liable at all times, as is also any dampness in the pipe, to be converted into steam by the heat of the melted lead. The steam sometimes breaks out, or "blows" through the clay, allowing the lead to escape.

(135) J. M. A., Philadelphia, Pa., asks: Is there any back pressure in the high pressure cylinder of a compound engine? The reason I ask is, that I believe there is, but another engineer insists that I am wrong, and says that there is no back pressure. I imagine that as the exhaust of the high pressure cylinder begins to expend its force on the low-pressure piston, there will be considerable back pressure in the high-pressure cylinder. We ask you to settle the argument. *A.*—You are right. At the time that the low pressure cylinder takes steam the back pressure on the high pressure piston will be somewhat greater than the initial pressure in the large cylinder, and after this the back pressure is reduced more or less during the stroke; the amount of decrease depends on the construction of the valve gear. 2 It is said that energy is indestructible. If I wind up a spring and then put it in an acid which will attack the steel, what becomes of the energy? I should think the energy is destroyed; if so, the above law will be knocked out. *A.*—The law of conservation of energy is so well established that it cannot be refuted. The energy in the spring under the given conditions will be converted into one or more other kinds of energy—heat will probably be the principal one. You may, however, rest assured that energy cannot be destroyed any more than perpetual motion can be invented.

(136) T. J. M., Sombrerete, Mexico, writes: Kindly enlighten me on a subject which has worried me for some time. What should be the number of revolutions of wheel for a centrifugal pump of any size, say the wheel is 1 foot diameter, length of suction pipe, 4 feet, and length of discharge pipe, 30 feet. Also give velocity of water at maximum speed? *A.*—The velocity of water should not exceed, say, 420 feet per minute, or 7 feet per second. Let v = velocity of water in feet per second = 7 feet; D = diameter of the wheel; d = diameter of the discharge; c = co efficient, say, .6; h = total head, that is, the head of the suction and discharge; and s = peripheral velocity in feet per second of the wheel, we then have,

$$\sqrt{\frac{(v^2 + 64 \times h \times c^2) \times D^2}{(D^2 - d^2) \times c^2}} = s.$$

If the diameter d of the discharge is one-half the diameter D of the wheel, the above formula reduces to,

$$\sqrt{\frac{v^2 + 64 \times h \times c}{.75 \times c}} = s$$

Applying the last formula to your example, we have,

$$\sqrt{\frac{7^2 + 64 \times 34 \times 6}{.75 \times .6}} = 54 \text{ feet}$$

per second, for the peripheral velocity of the wheel, or $54 \times 60 = 3,240$ feet per minute. Dividing this by the circumference of the wheel, which in this case is, say, 3 14 feet, we have,

$$\frac{3,240}{3.14} = 1,031 \text{ revolutions per minute.}$$

Your formula gives too high a speed.

(137) H. N., Bethlehem, Pa., writes: Please inform me what force will be required to raise a weight of 6,300 pounds through a distance of 2 inches; the force is applied to a hand-wheel 36 inches diameter? The weight rests on an eccentric; its eccentricity is 2 inches; it is keyed to a shaft, which also carries a worm wheel with 34 teeth meshing with a single threaded worm, which is keyed to the hand-wheel shaft. *A.*—The friction in this arrangement is very great; we should allow for it at least 75 per cent. of the weight to be lifted, which gives us a total load of $6,300 \times 1.75 = 11,025$ pounds. If the velocity of the force applied to the hand-wheel is uniform, the velocity of the load will not be uniform, consequently the force applied to the hand-wheel will be variable. Here, then, we have to find the maximum force, which will occur when the center line of the eccentric is in a horizontal position, the load, of course, moving in a vertical line. Since the worm wheel has 34 teeth, the hand wheel will have to make 34 revolutions while the worm wheel makes one, consequently, if the radius of the hand-wheel had been equal to the eccentricity of the eccentric, we would require a force of $\frac{11,025}{34} = 324.26$ applied to the hand-wheel, but its radius is 9 times the eccentricity; consequently, we have $\frac{324.26}{9} = 36.02$ pounds for the maximum applied force. 2. What will be the horse power required to lift the weight through a distance of 2 inches per minute? *A.*—Including friction, we may say that we have to lift a load of 11,025 pounds through $\frac{2}{12} = .166$ foot per minute; the horse-power required will be

$$\frac{11,025 \times .166}{33,000} = .055.$$

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears. Lex'n, Mass., & Phila, Pa. See p. 12.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith M. T. Co., Mill., Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

Chucks, the Nat l. est'd 1882. 39 Cortlandt St., N. Y.

Speed Gage McLauthlin & Co., Fulton St, Boston

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St, New York.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty S., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 3 Cortlandt St., N.Y.

Pulley lathes, most efficient offered. The Lodge & Shipley Machine Tool Co., Cincinnati, O

Engine Castings. Humphrey's Foundry, Bellefontaine, O.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Air Compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt street, N. Y.

Steam Pressure Regulators. Reducing Valves, Safety Checks. Foster Engineer'g Co., Newark, N.J.

Upright Drills, stationary head, W. & L., with or without B. G. J. E Snyder, Worcester, Mass.

M. E. Howard. Indianapolis. Ind. Specialty, 4 and 8 H. P engines in stock, write for price.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

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The Steam Engine. Rigg. New edition, price $10. Spon & Chamberlain, 12 Cortlandt street, New York.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

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American Packing Rings make pistons steam tight. Are simple, durable and inexpensive; write for circular. J. H. Dunbar, Youngstown, O.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

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"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO, 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid Published by John Wiley & Sons, 53 East Tenth street, New York.

Nothing but Common Sense.

I once worked in a little shop in the country, in which not a man knew anything about a steam engine. Water-wheels turned the shafting around. The nearest steam engine was a good ten miles away. One day the proprietor of that steam engine came to the shop and said he was badly fixed—engine wouldn't turn over. Man must go right out in the wagon to see what was the matter. Joe went out, stayed over Sunday, and came back smiling. When Joe explained how he fixed up things, his explanation was something like this: "When," said Joe, "that piston wanted to get moving on in one direction, the valve

ought to let steam behind it to move it. I fixed it," said he, "that way, and it seemed to go all right."

Improved Universal Cutter and Tool Grinder.

In a former issue of this journal we have illustrated and described a universal cutter and tool grinder, made by the Cincinnati Milling Machine Company, of Cincinnati, Ohio, which machine was the prototype of the one we now illustrate, and the capacity of which, especially with respect to the variety of work done, has been very much extended.

Provision is now made for giving rotary motion by belt to work held upon centers and such work, including reamers, arbors cutters, etc., may be so ground up to 8 inches diameter, 15 inches long; while straight-face cutters, metal-slitting saws, inserted tooth mills, etc., can be ground up to 14 inches diameter. It is also arranged for grinding cylindrical, conical and flat surfaces, such as hardened spindles, arbors, bushings, cam rollers, concave sides of cutters and saws, and the face of punching dies, hardened gauges and template, and a great variety of small machine parts can also be finished to an advantage by grinding on this machine.

Owing to the fact that the machine is truly universal, any form of cutter can be ground without the use of special attachments, and all work is done on a horizontal slide.

An especial advantage in grinding taper reamers, and radial or angular teeth of cutters, is in the fact that the tooth rest is set by gauge to the height of the center of the work, and the clearance is obtained independently of the adjustment of the rest; thus giving a uniform angle of clearance, and much simplifying the adjustment. The tooth rest moves with the work, except in grinding taper reamers, and it is made like a spring, so that it acts as a pawl, and passes from one tooth to another very readily.

The side teeth of angular and side milling cutters are ground with a practically straight-line clearance. This is done with a cup-shaped emery wheel, 3 inches in diameter, on the left side of the machine. The advantage of grinding side teeth with a fair sized emery wheel, and at the same time grinding a straight line clearance with a corresponding strong cutting edge, is well understood.

An important feature of this machine is, that the table may be swung around on the column, so that the work can be brought into contact with the emery wheels on either side of the machine. Some of the advantages of this feature are as follows: Work may be brought into contact with wheels in the most favorable manner for rapid grinding without heating the cutter. A side milling cutter may have the top teeth ground off on the disk emery wheel at the right, and the side teeth on the cup-shaped wheel at the left, without taking the cutter off the arbor or disturbing the tooth-guide.

The table is moved forward and back by means of a lever, which can be placed to suit the position or convenience of the operator. For the rapid adjustment of table towards the emery wheel, the holder carrying it slides on a shaft, while for the fine adjustment of grinding a screw is used. The table is elevated or lowered by means of a rack and pinion, and has a vertical adjustment of 3⅜ inches. It is 20¾ inches long, and has a horizontal movement of 12 inches. Adjustable dogs for stops on each end are provided. The table makes a complete revolution on slide and may be set at any angle to 90 degrees. All adjustments of table and swiveling head are indicated in degrees.

The spindle is hardened and ground and runs in bronze bearings. It is provided with dust caps and adjustment for wear. It has but one speed. All the wheels furnished with the machine have been selected for the various work illustrated, and operate best at the speed given. Endless belts may be used, as the spindle head may be moved up or down for adjusting them. A hand rest is furnished for turning off the emery wheels and grinding other work by hand.

The countershaft furnished with this machine for driving the emery-wheel spindle is complete, including a novel device for shifting the belt. The loose pulley is made smaller in diameter than the tight pulley to relieve the belt when machine is not being used.

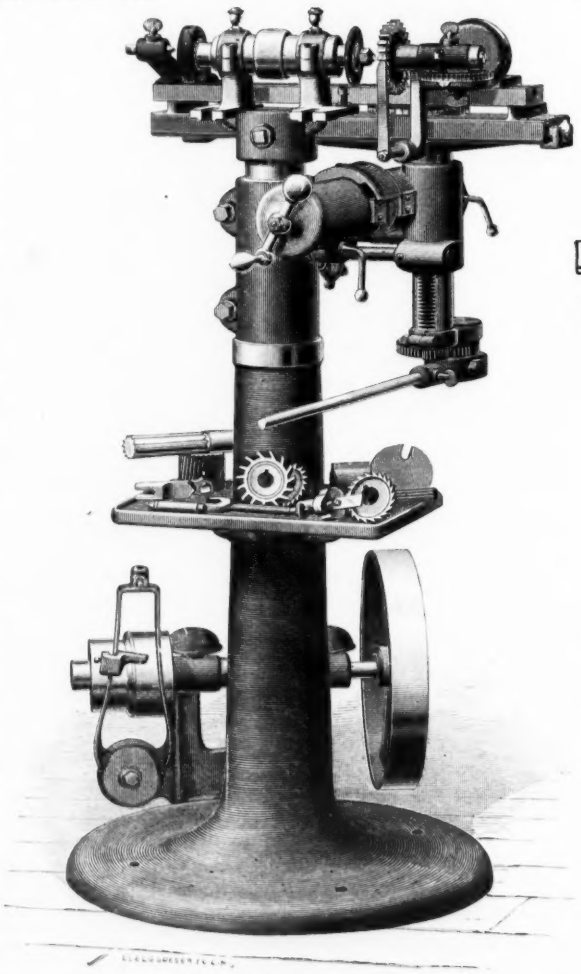

Fig. 1.

Improved Universal Cutter and Tool Grinder.

Fig. 2 shows the relative position of parts in grinding a spiral mill, the gauge for setting the tooth rest being indicated.

Fig. 3 shows the arrangement for grinding slitting saws larger than 8 inches, and up to 14 inches diameter.

Fig. 4 shows the method of grinding patent relieved gear cutters. It is recognized that such cutters, in order to work to their full efficiency, and produce correctly

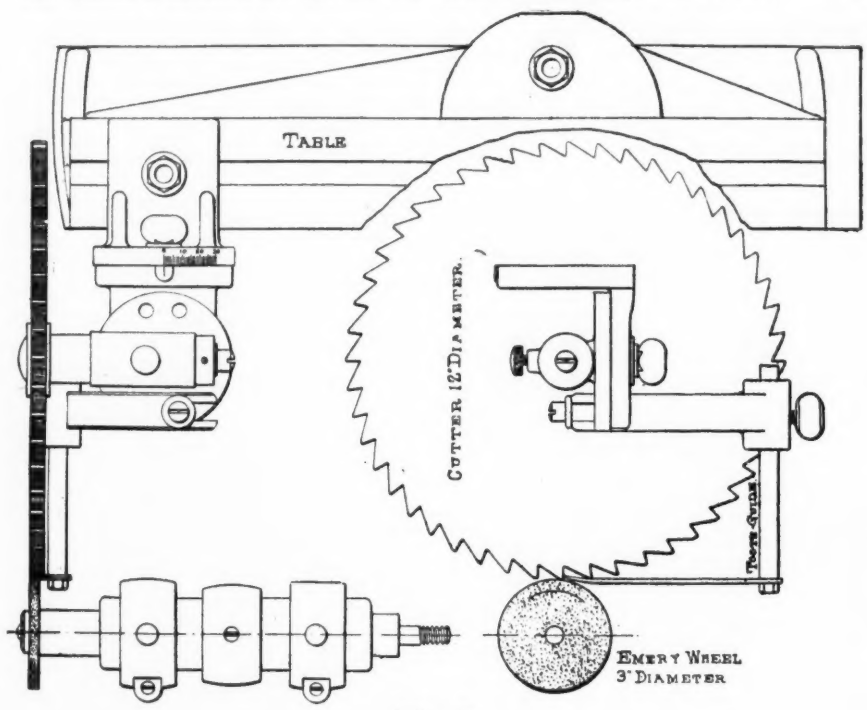

Fig. 3.

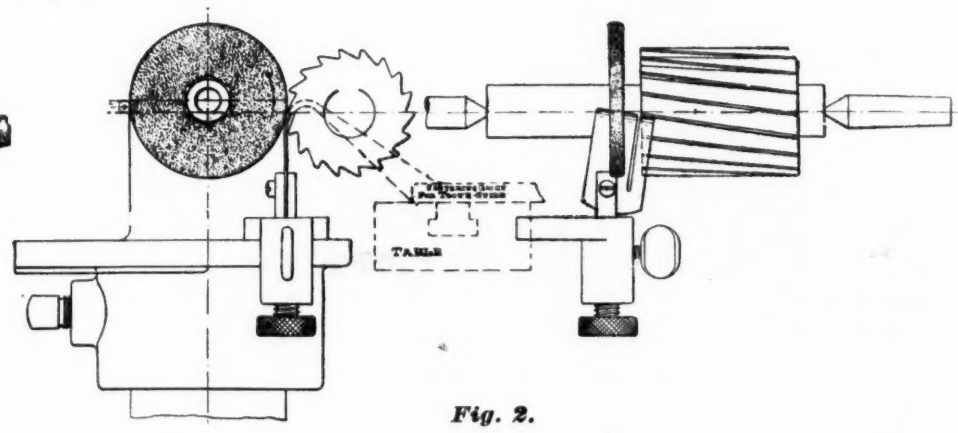

Fig. 2.

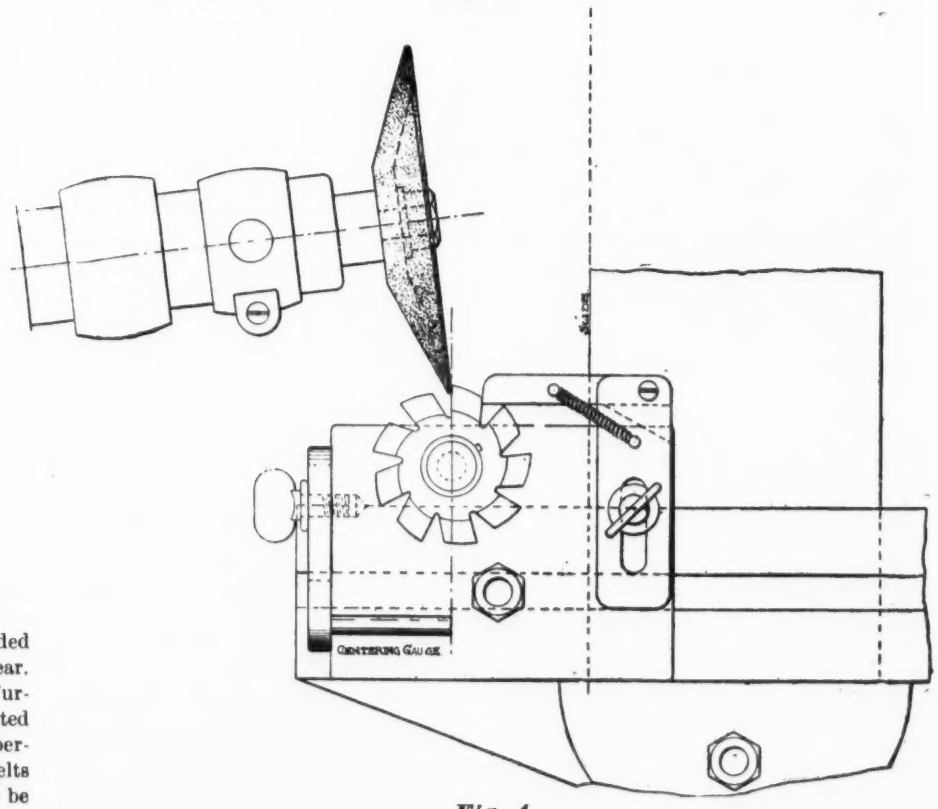

Fig. 4.

shaped gear teeth, should not only be ground with precisely radial faces, but that all the teeth should be ground back equally. In this machine, the above mentioned conditions are secured by holding the cutter upon a short, vertical stud upon which it is free to revolve, and gauging the position of the tooth being ground by the gauge shown, which is hinged at the right, and brought back to its place by the small helical spring shown after each tooth passes under it.

At Fig. 5 is shown the method of grinding rose reamers and similar work which is held on centers, and the table swung around to an angle of about 30 degrees.

At Fig. 6 is shown a hand reamer held on centers, and being backed off by a cup wheel; the result being that the surface of the top of the tooth is practically a plane, and the desired clearance is obtained with a stronger and more durable edge than is possible where the surface is concave. For reamers with very fine teeth the table can be raised so that the upper edge of the wheel does the grinding.

At Fig. 7 is shown the method of grinding a shell facing cutter, or mill; a spiral tooth rest being used for this work. For taking finishing cuts on planers with broad feed, it is essential that the cutting edge should be straight. This condition is readily obtained by the method illustrated in Fig. 8, though still better results in this line are obtained by using a swivel vise, which is furnished to order, and by which all necessary clearances can be ground upon such a tool, and the cutting edge can be made diagonal to give a shearing cut, if desired. This vise, together with some other features of the machine, will be illustrated next week.

As an offset to the multiplication of overhead electric wires in Jersey City, the firemen are to be furnished with rubber gloves. A more sensible plan would be to abolish the overhead wires.

It seems a little strange, when it is considered how easily, apparently, a ship goes down with all on board, that the safety of vessels at sea is constantly threatened by disabled and deserted vessels that seem to float around loose for years. Some time since it was proposed that the "new navy" take a hand in ridding the sea of these derelicts by blowing them up, but little seems to have been done in this direction.

Test of a Yarrow Boiler.*

The *London Times* of November 22, 1893, contains an account of a test of one of the water-tube boilers intended for H. M. S. torpedo boat destroyer "Hornet," a sister to the "Havock." The type of boiler was described and illustrated on Page 947, of Volume V., of the *Journal*, and the one tested had a grate 6½ feet long, 20.6 square feet of grate surface, and 1,027 square feet of heating surface. The following is the account of the test:

To test the boiler under the worst conditions of working, it was placed in the open without shelter and exposed to the fog which prevailed on the day of trial. In the presence of several engineering experts who were in attendance, the boiler, filled to its proper working height with cold water of the temperature of the surrounding air, had its fire lit at 2:20 P. M.; at 2:30 P. M. the steam-gauge pointer began to move; at 2:36 P. M., the gauge showed 60 pounds pressure of steam; at 2:40 P. M., 100 pounds, and at 2:42 P. M. a pressure of 180 pounds per square inch was registered. The boiler not being within any inclosed space, to produce the same effect on the fire as obtains in the application of forced draught on shipboard a steam blast, as in an ordinary locomotive, was applied in the funnel. This was put on at 2:40 P. M., when the gauge indicated 100 pounds pressure, so that in two minutes after its application the pressure increased 80 pounds per square inch. The blast being under entire control, the air pressure used could be ascertained with exactness, and from readings of the gauge did not exceed 3½ inches. From 2:42 P. M.—two minutes after putting on the blast—until the conclusion of the trial, at about 3:20 P. M., steam was maintained and was blowing off at the full pressure of 180 pounds per square inch, showing that with a much less pressure of air than was used an ample supply of steam at that pressure could be relied on. As a crucial test of its effect on the construction and the fitting of the tubes of the boiler, the fire (which was in a glowing state at the time), was at 3:20 P. M. as quickly as possible withdrawn, and every access for the surrounding air to reach the interior of the furnace allowed; but on examination not the least sign of a weep, or anything approaching it, from any of the tubes was perceptible—a fair proof of excellent workmanship and the soundness of the principle upon which the boiler is designed.

The boiler is in form and construction so exceedingly simple, yet, at the same time, so novel, that we may fitly conclude our notice of its trial with such a description of it as should be understood by all our readers. In form, looking at it from the front, it is like the Roman capital letter A, surmounted by a circle at the point where the two sides of the letter meet. The circle is a cylindrical-shaped vessel or chamber, some 7 feet 6 inches long, into which the two sides of the letter, which are a series of small copper tubes one inch in diameter, penetrate, the lower ends of these being fitted into the serifs or feet of the letter, which in the boiler are semicircular bottomed chambers. The cross-bar of the letter—but lower down than in it—would represent the fire grate bars. Here we have the whole boiler. Water is pumped into the upper cylindrical chamber, flowing down and filling the side legs or tubes, and is continued until the upper chamber is nearly half full. The fire is made on the cross-bars between the side legs, and the flame and radiant heat, passing in among the tubes, boil the water in them and convert it into steam, which rises in them to the surface of the water in the upper chamber, and is there collected and confined until required for use. The circulation of the water is here absolutely perfect, the rows of tubes nearest the fire acquire the greatest heat, and the water in them is, in consequence, made sensibly lighter and ascends, while that in the outside rows, being cooler, and therefore heavier, follows the natural law and descends, and takes the place of the previously heated water, thus keeping up a continuous movement and circulation of it.

In confirmation of this efficient circulation of the water in the boiler under description, the evaporation in it on the trial was calculated to have reached 12,500 pounds of water per hour, or 100,000 pounds for the eight boilers to be fitted in the "Hornet." A comparison of this with the two locomotive boilers of the "Havock," whose evaporation was 54,880 pounds per hour, her engines indicating 3,400 horsepower, would give the boilers of the "Hornet" a power equal to 6,250 indicated horse, an amount largely in excess of what would ever be required from them.

Comparing the weights of the two sets of boilers, those of the "Havock," when full, weighed 54 tons, while the "Hornet's," complete, with all fittings, will not exceed 43, or a saving of 11 tons, which, in vessels of the class, is considered by the naval authorities an item of first importance.

* From the *Journal of the American Society of Naval Engineers.*

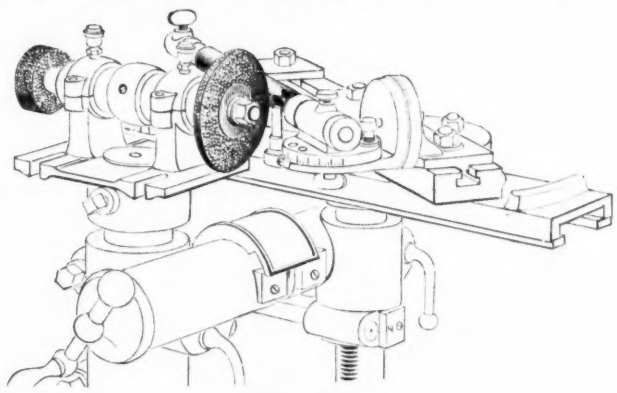

Fig. 5.

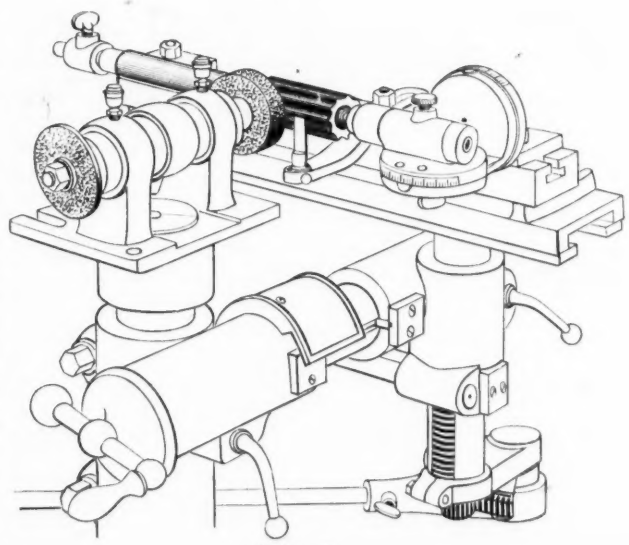

Fig. 6.

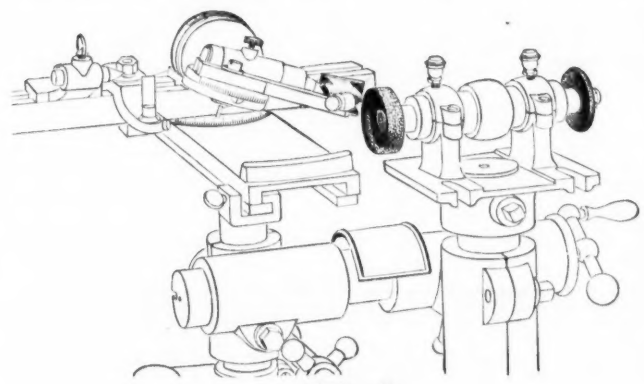

Fig. 7.

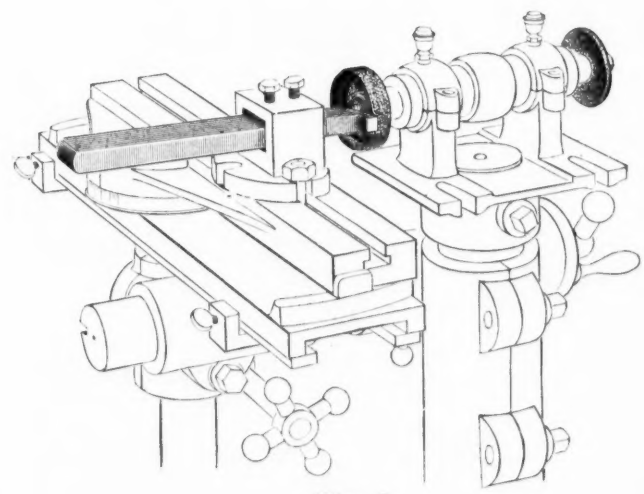

Fig. 8.

IMPROVED UNIVERSAL CUTTER AND TOOL GRINDER.—See page 10.

Aluminum Lifeboats.

A Washington dispatch says: Naval Constructor J. J. Woodward and J. C. McGuire, of the Navy Department, returned from Baltimore this morning, after having tested the aluminum boats, which have just been made by a firm in that city for the Wellman Arctic expedition. The first boat completed, which is 18 feet long, 4 feet beam, and 2 feet deep amidships, weighing 350 pounds, was thoroughly tested and was found to be even more stable than was expected. The boat was put in the water empty, and a man tried to capsize it by sitting on the gunwale and hanging outside, but it was impossible to overturn it. It was then loaded with sandbags weighing 3,333 pounds, and seven men weighing 1,128 pounds also got on board, making 4,461 pounds in all. Even with this great load the boat remained 5½ inches out of the water amidships. The boat was then unloaded and the air tight compartments were tested by capsizing the boat. But it was found impossible to get it more than half-full of water, since the compartments held it so high out of water as to act on the principle of a self-bailer. The boat was then taken alongside the wharf and filled with water until the gunwale was flush with the surface, and then a man got on either end over the air-tight compartments. Still the boat did not sink, and as soon as it was cast loose, it heeled over and emptied out one half the water and then righted itself. The air-tight compartments were subsequently tested by being filled with water, and when the doors were screwed down, the boat was rolled over, and the compartments were found to be perfectly tight.

Two of the boats are not quite finished, but when they are completed they will be subjected to similar tests. The two naval experts who made the test have been requested by Secretary Herbert to make a full report in writing to the department. All of the boats will be tested, and an official report made upon them to the Navy Department before the expedition sails. The Secretary of the Navy is very much interested in the matter, and some of the other department authorities believe that there are great possibilities ahead for aluminum boats for the Navy.

Old Belting Renewed.

A machine has been invented which is expected to strengthen old belting. This machine consists of two large hollow copper cylinders. Steam is admitted into these cylinders and thus they are always heated. In a tank there is a solution made of bees' wax, borax, glue, starch and molasses, prepared in equal quantities. The solution is in liquid form. There are guide rollers, and the leather belting which is in process of treatment runs through them. The belt to be operated upon is started into the machine at a point where it can enter the tank, and while passing through this tank the leather receives an application of the solution. The press rollers immediately squeeze the compound into the fiber of the leather and then the heat from the cylinders, over which the belting is being drawn, dries the compound. All the rollers and cylinders rest in the bearings. The result of applying this compound to the belt and immediately drying it is said to add strength to the fiber of the leather to a remarkable degree.—*Machinery.*

A marvelous race, up grade and down, in which momentum was the motive power, took place on the Consolidated Road Saturday. Five miles below Stamford the cylinder head of the big engine, No. 247, blew out while the train was making express time. Instead of stopping and getting stalled, Engineer Scofield let the machine have its head and pulled into Stamford station on time, and not even the conductor knew that anything was the matter until the engineer called for another engine and No. 144 was put on and pulled the train to this city. The five miles was run without a pound of steam, and solely on the momentum the train was under when the mishap took place.—*New Haven Daily Palladium.*

Sometimes we may wonder why men do not get at the head in departments of the government where high mechanical skill is required, whose education and work fit them for such positions. For years the reason has been politics, but common sense may get to the front after a time. The matter is worth thinking about. A carpenter is hired to build a house and a blacksmith to shoe a horse, but further up along, in government matters, this does not seem to work.

The navigator takes with him a chronometer, which is potent in locating his position after months of absence from any point that is known. The balance wheel of that chronometer has vibrated millions of times, it may be, but it has turned out the seconds with such accuracy that the variation is hardly worth noting. This is owing to the skill of the mechanician. All the science in the world could not bring about such a result. Figures go astray when such results are to be reached. It is then that the skill of the mechanic comes to the front.

An item is going the rounds showing the wonderful educational effects of sleeping with a candle, pencil and pad by the bedside, ready to jot down anything that may come to the mind in wakeful moments. The particular case mentioned is that of a lawyer. We knew of a mechanical engineer in charge of a large works who practiced this, but nature objected too early in the process to enable much to be noted of the result.

Careless management about boilers is not all confined to the present time. In 1827, while trying a new steamboat at Lyons, France, the engineer in charge of the trial, vexed because the boat would not make headway against the current, weighted down the safety valve, the result being a terrific explosion, by which many persons were killed.

The agitation in favor of good roads in this country is bearing excellent fruit. Not only do the people take kindly to the plan, but the railroad companies promise to carry material required in road-building at nominal rates. Good roads are in the interest of everybody, and there is no grounds for opposition. Probably invention is not yet through with the problem of making good roads, but for the present it is wise to work on well-defined lines.

Dynamite serves the farmer useful purposes in blowing up stumps, but it sometimes works unsatisfactorily, as when, for example, several charges were buried in a large and valuable section to get rid of foxes that were infesting it and committing depredations in the neighborhood. The dynamite failed to explode, and not being accurately located no one, naturally enough, dare work the land, and no one, of course, is desirous of buying it.

According to English papers, there is a good deal of excitement in that part of the world over the matter of induced draft as against forced draft on warships, it seemingly being considered as something new. Induced draft had its day here several years ago in connection with land boilers. It was a pretty big failure, but it may work well in marine practice.

The total number of immigrants arriving at New York, Philadelphia, Boston and Baltimore during the year 1893 was 431,712. It is believed that other arrivals would swell the number to 530,000.

MANUFACTURES

The new Harveyizing plant of the Carnegie Steel Company, at Homestead, Pa., has been completed at a cost of about $1,000,000, and a test plate will soon be shipped to the proving grounds at Indian Head.

The Curtis Electric Works, Lafayette, N. J., are to resume work after being closed down for three months. About three hundred men are employed in the works, and it is thought they will run day and night for some months.

A company to be known as the Morgan Pump and Conveyor Company, of Kansas City, Kan., have been organized to manufacture pumps and other appliances under letters patent granted to Waitman M. Morgan. The capital stock of the company is $100,000.

The capital of the Hartford Manufacturing Company, which is engaged in business at the Colts Armory, in Hartford, has been increased from $15,000 to $40,000. Several well known capitalists of that city and the adjoining towns have purchased stock in the concern.

The Lodge & Shipley Machine Tool Co., Cincinnati, O., have recently received, with other orders, several orders for their celebrated motor gear lathe, also triple facing machine and engine crank disk turning and boring lathe. This company makes a specialty of machines to rapidly produce work heretofore done in lathes.

American Fuel Economizer and Engineering Co., 136 Liberty street, New York, issue a fine catalogue which very fully illustrates and describes the fuel economizer which they are putting on the market. This economizer is for heating and purifying the feed water for steam boilers by utilizing the heat in the flue gases.

The Emlyn Iron, Steel and Tin Plate Company has located at Summitville, Ind., where work has begun on the erection of a plant which will give employment to about 350 men within six months and many more later on. Nearly all the machinery has been contracted for, and the Big Four railroad has begun the laying of side tracks.

A charter has been granted to the Petersburgh (Va.) Iron Works. The object of the company is the building of dredges, scows, tugboats and other such craft, and the manufacture of iron products, such as engines, boilers, machinery, castings, etc. The principal office is to be in Petersburg. The capital stock is not to be less than $10,000 nor more than $100,000, divided into shares of $100 each.

The Leechburg (Pa.) Foundry and Machine Company has received the contract to change the sheet-mills of the Ellwood (Pa.) Tin Plate Company into tin plate mills. The outfit will consist of a complement of chilled rolls, additional cold rolling mill, 4 doubling shears with engines, 2 Mesta patent squaring shears, 1 Mesta patent pickling machine, including crates, vats, etc. When the above changes and additions are made it will be a complete 4-mill tin plate plant.

The 1894 catalogue of Globe Special Castings, by the Builders Iron Foundry, Providence, R. I., is somewhat larger than last year, and contains a revised price list. Globe special castings are for water works, public or private, and there are a variety illustrated in the catalogue of both common and uncommon forms. Some space is given in the catalogue to a cut and description of the venturi meter. The catalogue is a very neat one, small enough for the pocket, with blank memorandum leaves at the back.

The Ellwood Tin Plate Company is the name of the new concern which has succeeded the Ellwood Steel Company. Operations have begun to change the mill, and the work will be pushed as rapidly as possible. About 250 hands will be employed when the works get in operation. The mill will make black plates for tin plate exclusively, though tinning will not be started at present. A. M. Brown, of Cambridge, O., who is managing the plant, states that the mill will be run on three turns and will have a capacity of 25 tons daily.

The New Jersey Zinc and Iron Company, at Newark, N. J., have placed the order for the iron roofs on their new buildings with the Berlin Iron Bridge Company, of East Berlin, Conn. The furnace room will be 50 feet wide and 400 feet long, made entirely of brick and iron. The engine room, fan room and boiler room will be 60 feet wide and 187 feet long, the engine room covered with slate, and the fan room and boiler room covered with corrugated iron. The Philadelphia Gas Improvement Company, of Philadelphia, Pa., have placed the order for the iron roof over their new coal shed with the Berlin Iron Bridge Company.

The letter following is typical of many we are receiving, and which lead us to believe that the backbone of the business depression is broken: "Business is improving very nicely with us, and we are very sanguine that the worst is over, and that while we may not shortly expect any boom, still we believe that the year will wind up very satisfactorily. We are, yours truly, Sebastian Lathe Co., Cincinnati, O."

The Lodge & Davis Machine Tool Co., of Cincinnati, O., are building for the Card Electric Motor and Dynamo Company, of the same city, one of their large standard engine lathes to be driven by electricity. The motor will be placed in the headstock, taking the place of the usual cone pulley, and attached direct to the live spindle. B. B. Quillen.

The Gates Iron Works have purchased the plant of the Chicago Iron Works, at the southeast corner of Willow street and Hawthorne avenue, Chicago from Rockwell King, receiver, for $25,000. The ground fronts about 300 feet on Willow

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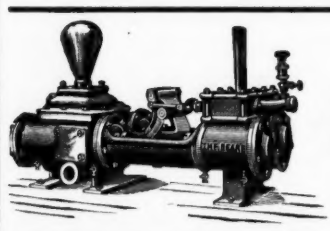
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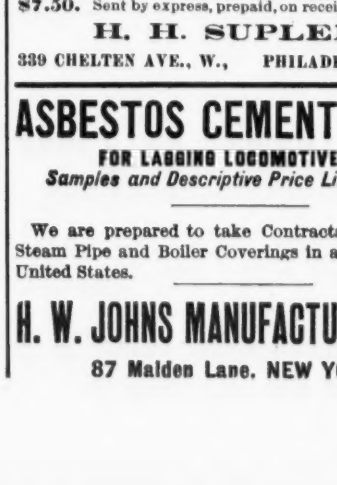

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street, and 250 on Hawthorne avenue. The plant comprises a large brick factory, 150x200 feet, with pattern lofts, traveling cranes, etc. There are large blacksmith and wood-working shops, and also a large number of patterns of the most modern mining machinery. The plant is equipped with about $60,000 of machinery. In addition to this there is a valuable lease on the ground, running for 25 years, at a low rate. The Gates Iron Works have been located at 50 South Clinton street, Chicago, for 53 years. They will operate both plants, and next spring will build large shops and a foundry on the grounds just purchased, and move the Clinton street establishment to the one just acquired.—*Iron Age.*

The Tradesman, of Chattanooga, Tenn., in its weekly review of the industrial situation in the South for the week ending March 5, 1894, says: Improvement now is the rule in Southern industrial and mechanical circles. The number of newly established industries is above the average. Enlargements of manufactories to meet increasing demands are in large numbers, and inquiries for machinery of all kinds continue to be heavy. During the past week the textile and woodworking industries have been especially active. Prices for iron and coal continue to be low, but there is an increasing demand preventing accumulation of stocks in first hands. *The Tradesman's* reports from all points in the South as to business conditions are uniformly encouraging and satisfactory. *The Tradesman* reports 49 new industries established in the South during the past week, prominent among which are: The Bancroft Coal Company, capital $200,000, at Charleston, W. Va.; a $100,000 ice factory at Dallas, Texas; the Petersburgh Iron Works, of Petersburgh, Va., capital $100,000; the Dodson Printers' Supply Company, of Atlanta, Ga., capital $100,000; the Spring Creek Oil and Gas Company, capital $100,000, of Spencer, W. Va.; and the Bartlett Paving Company, of New Orleans, La., capital $100,000. Electric lighting plants are to be built at Cochran, Ga., by W. H. Mobley, and at Georgetown, Texas, by M. P. Kelley & Co. Lawler & Son will establish flouring mills at Martin, Tenn., and others will be built at Clifton and Morgan, Texas, and Quebec, Tenn. A $40,000 water and light company has been chartered at Bastrop, Texas, and a $100,000 coal and lumber company at Charleston, W. Va. Cotton mills are reported at Abbeville, S. C., Newport News and Petersburgh, Va., and woodworking plants are to be built at Little Rock and Center Point, Ark., Apalachicola, Fla.; Abbeville, Ala., Port Royal and Sumter, S. C., Charlotte, N. C., Colmesneil and Oak Cliff, Texas, Meridian, Miss., and Hamilton, W. Va. Among enlargements of the week as reported to *The Tradesman*, are brick works at Rome, Ga.; a tannery at Alexandria, Va.; cotton mills at Newnan, Ga., New Orleans, La., and Pacolet, S. C., and woodworking plants at Cargile, Ark., Meridian, Miss., Bristol, Tenn., and Portsmouth, Va. *The Tradesman* also reports for the week the following important new buildings: Business houses at Cordele, Ga., Louisville, Ky., and Starkville, Miss.; a $30,000 court house at Forsyth, Ga., and a $50,000 one at Sulphur Springs, Texas; a $25,000 office building at Fort Worth, Texas, and an opera house at Memphis, Tenn.

Machinists' Supplies and Iron.

NEW YORK, March 10, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $13.00 to $14.00; No. 2, $12.50 to $13.25; Gray Forge, $11.75 to $12.50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $11.75 to $12.50 for No. 2, and $10.75 to $11.25 for Gray Forge.

Antimony—The market is steady and quiet. We quote L. X., 9¼c. to 9⅜c.; Cookson's, 10c. to 10½c.; Hallett's, 8¾c. to 9c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 65c. to 66c.

Copper—There has been no change in the market, the demand is exceedingly light, holders are not willing to sell at the present low prices. Lake Copper is quoted at 9.70c. to 9.75c. Casting Copper is held at 9¼c. to 9⅜c.

Lead—The market is firm at 3.30c. to 3.35c. The producers are firm in their views and will not sell at a lower figure. There is some speculative interest, several hundred tons being sold at 3.30c. for spot and near-by supplies.

Spelter—The market is quiet, holders are firm in their views at 3.85c. to 3.90c. for New York delivery; the movement is limited to single car loads. There is no speculative interest.

Tin—The market is somewhat firmer, 18.80c. is asked for prompt or future delivery, 18.60c. is bid.

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Mechanical draftsman, Swede, wants position. Box 35, AMERICAN MACHINIST.

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(*Continued on page* 14.)

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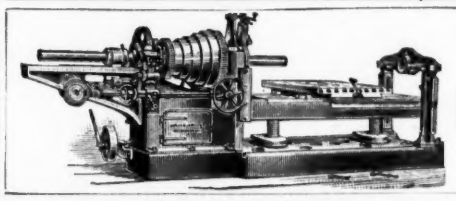

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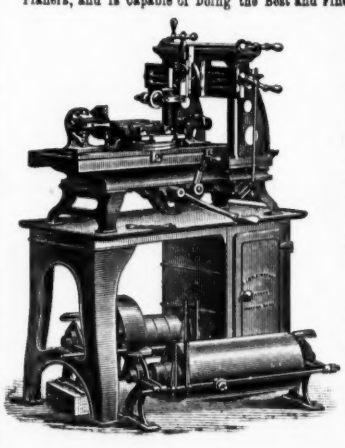

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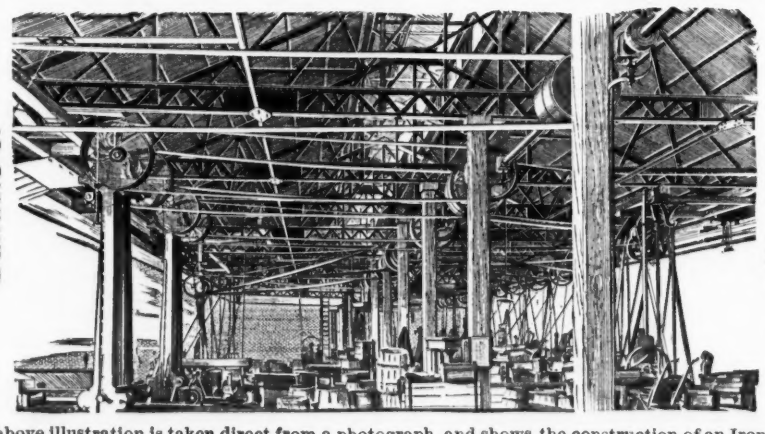

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for the Upson Nut Co., at Unionville, Conn., over their Forge Shop. The building is 45 feet in width by 184 feet in length, with brick walls and iron roof trusses covered with corrugated iron. No wood-work is used about the construction in any way, shape or manner, so that the danger from fire is entirely eliminated. Extending the full length of the building, on the ridge, is a ventilator with swing shutters which open and close by cords from the floor.

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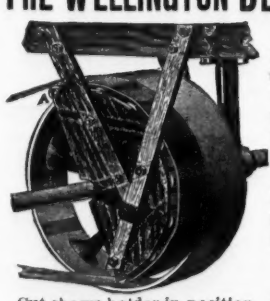

Large or small belts shifted from driving pulley and held at rest, and easily slipped back when machine is to be started.

It dispenses with loose pulleys, saves belts, and is perfectly safe.

It is *cheap.*

Write for descriptive circular and price list to

Cut shows holder in position beside driving pulley.

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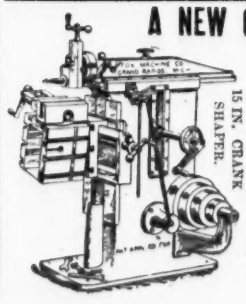

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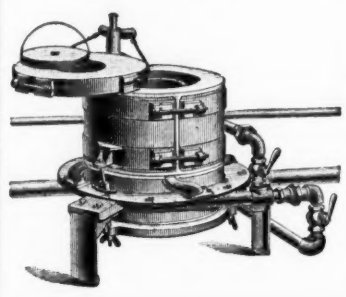

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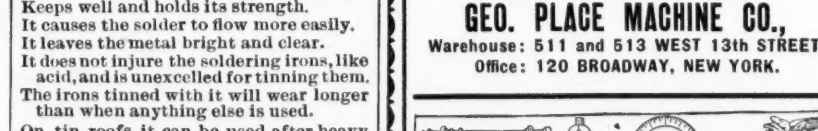

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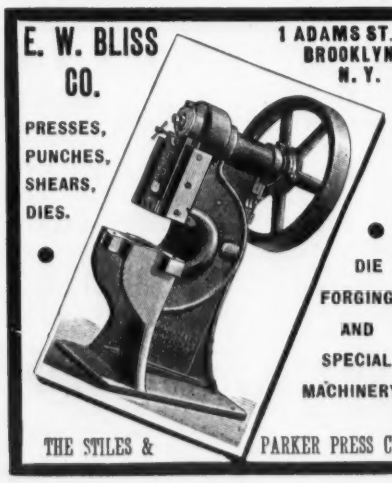

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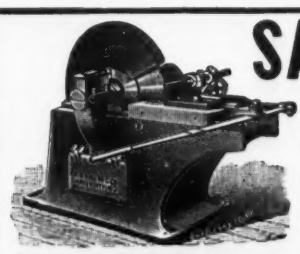

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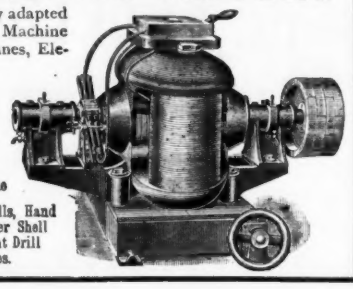

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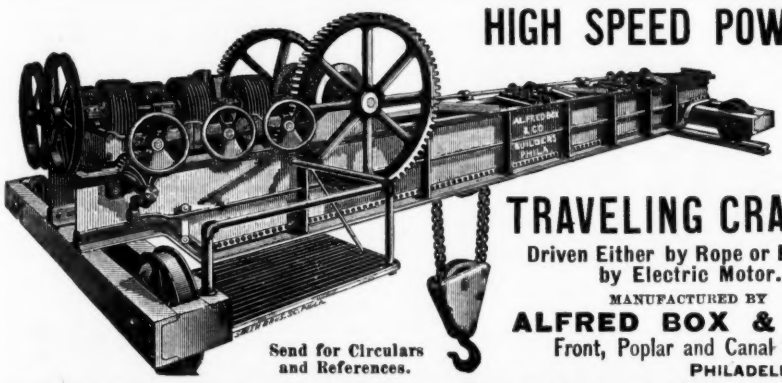

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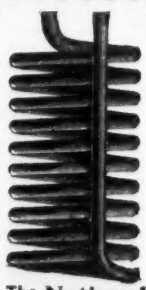

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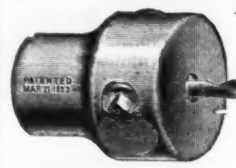
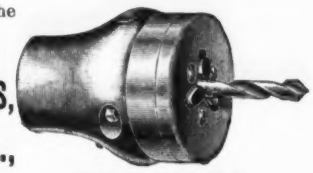


Style B, Two-Jaw.



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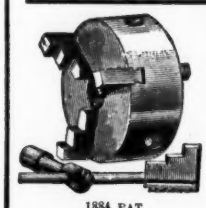

1884 PAT.

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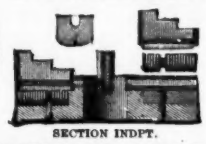

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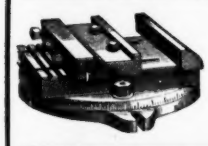

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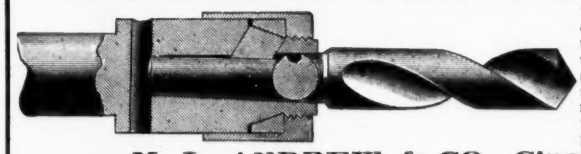

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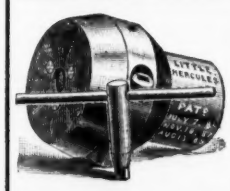

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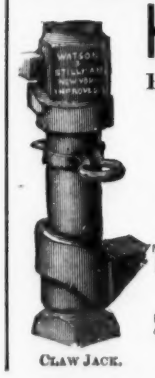

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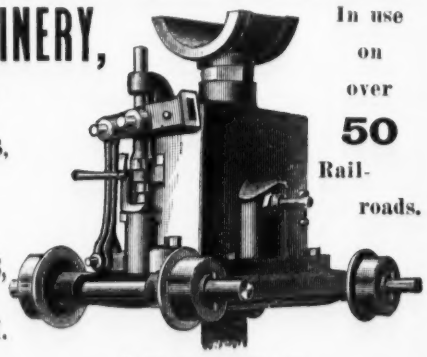

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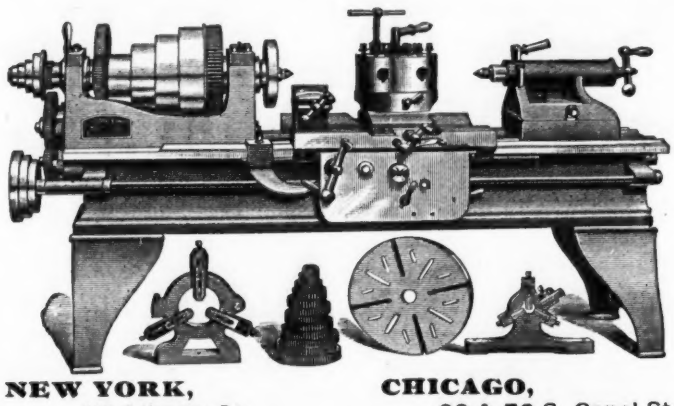

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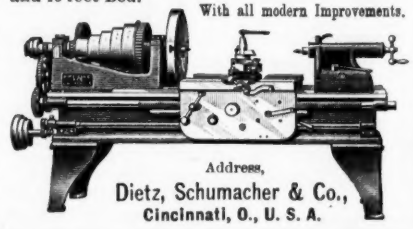

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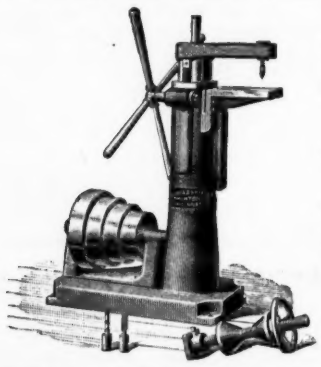

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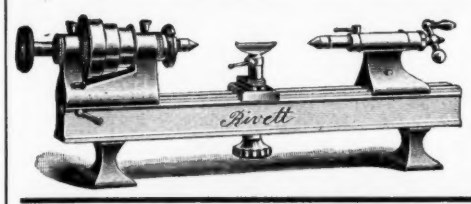

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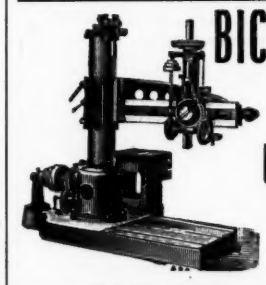

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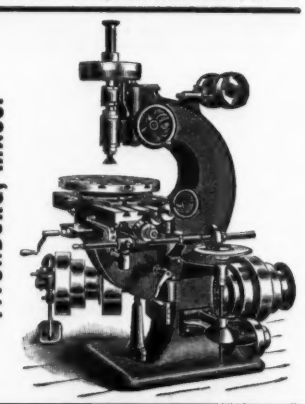

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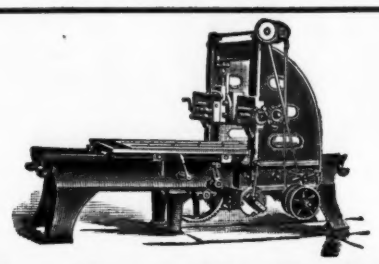

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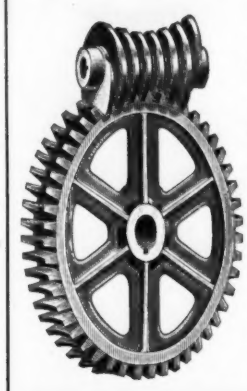

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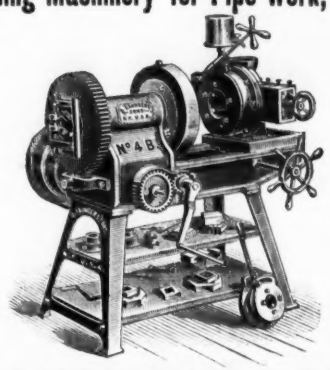

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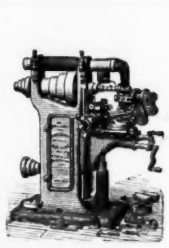

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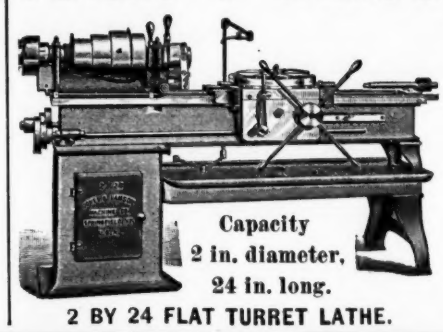

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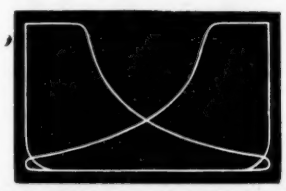

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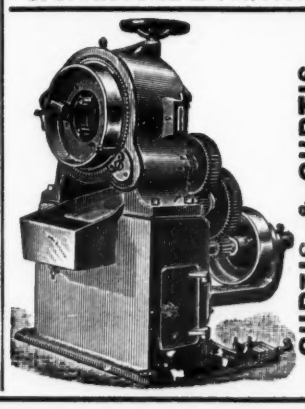

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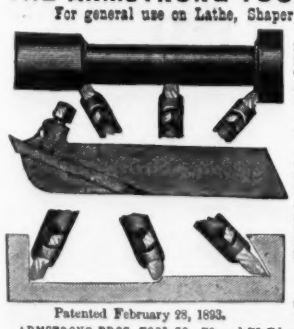

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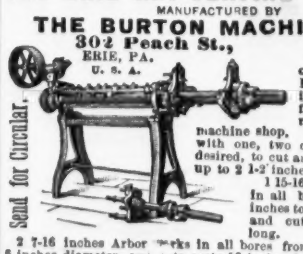

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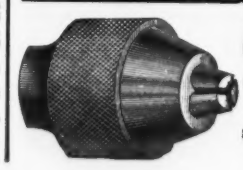

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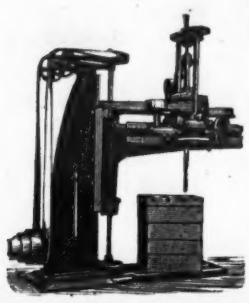

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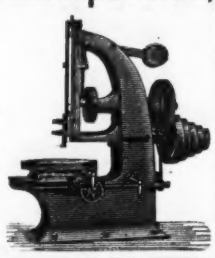

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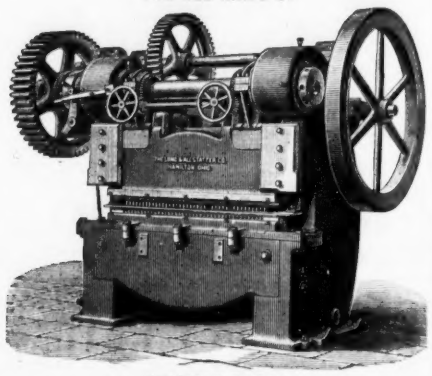

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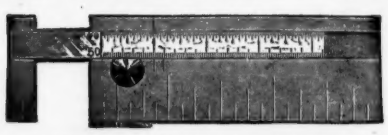

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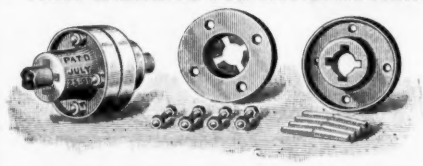

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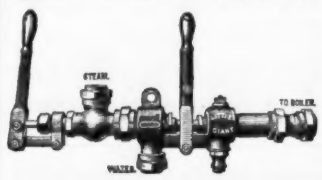

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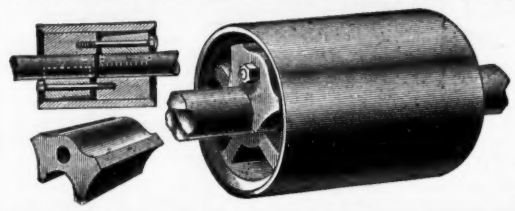

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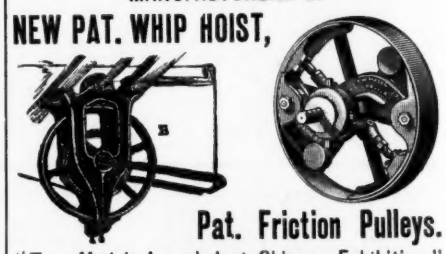

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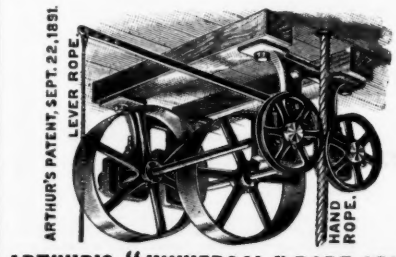

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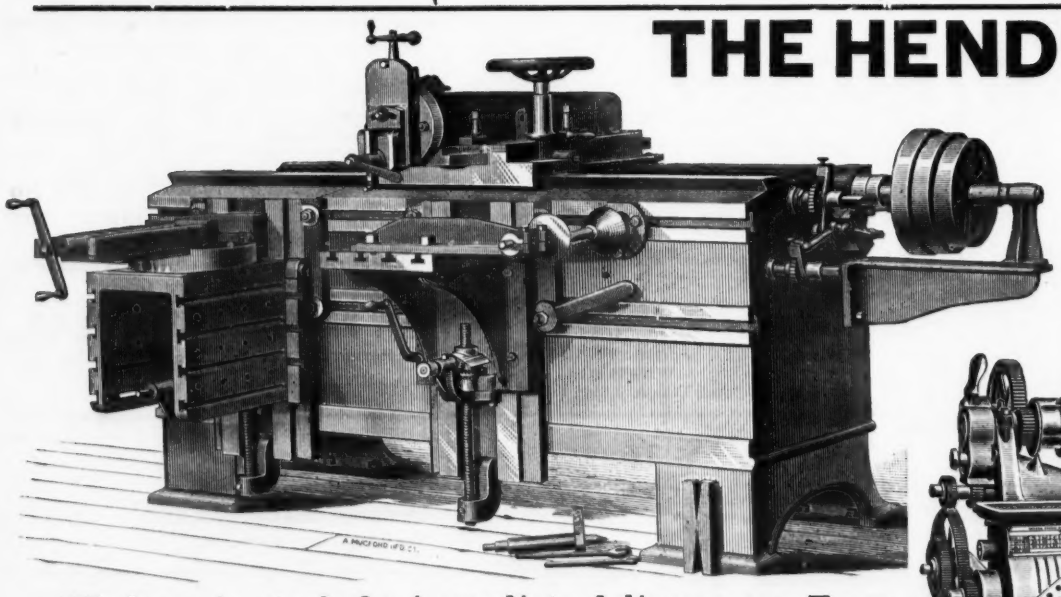

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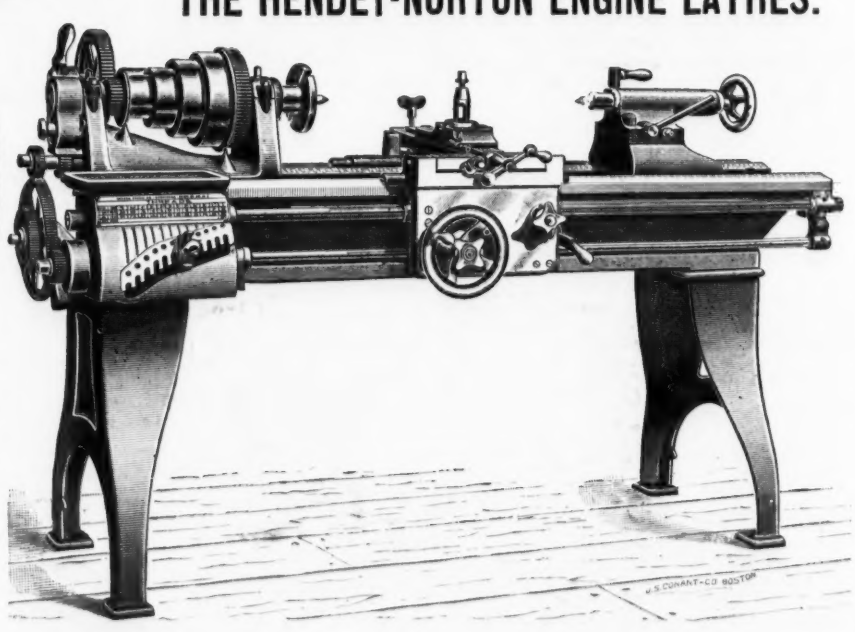

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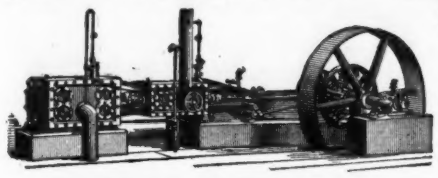

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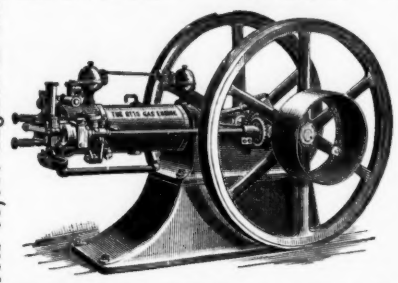

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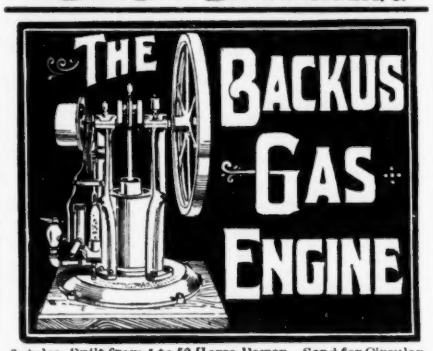

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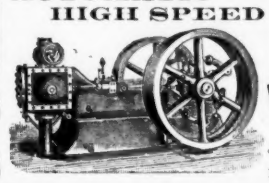

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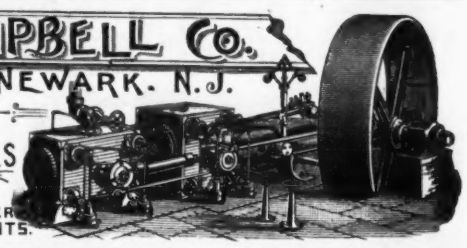

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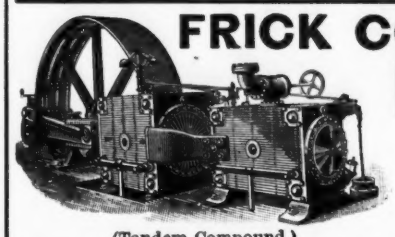

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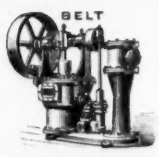

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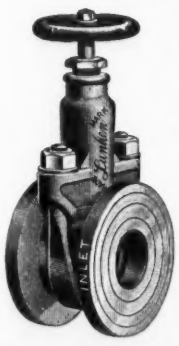

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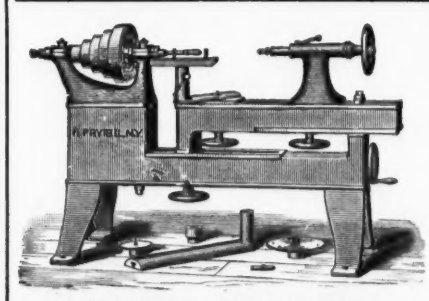

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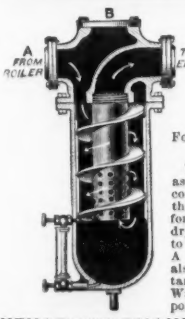

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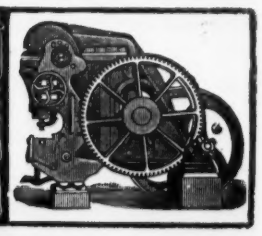

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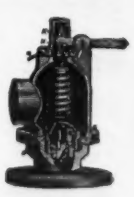

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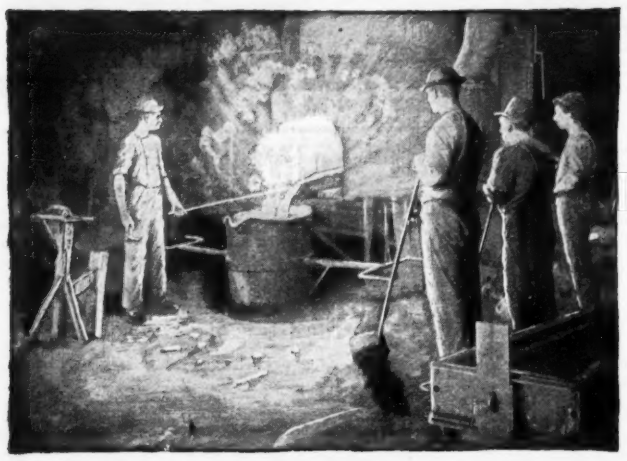

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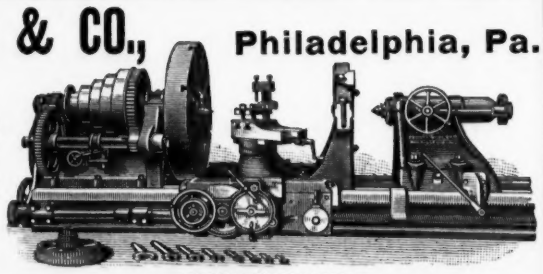

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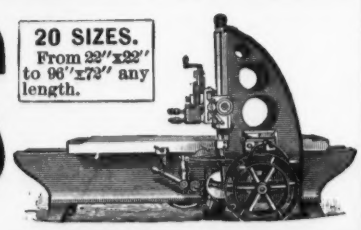

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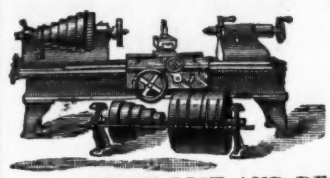

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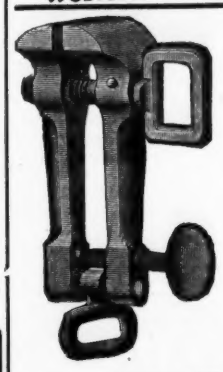

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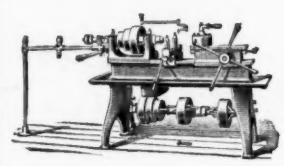

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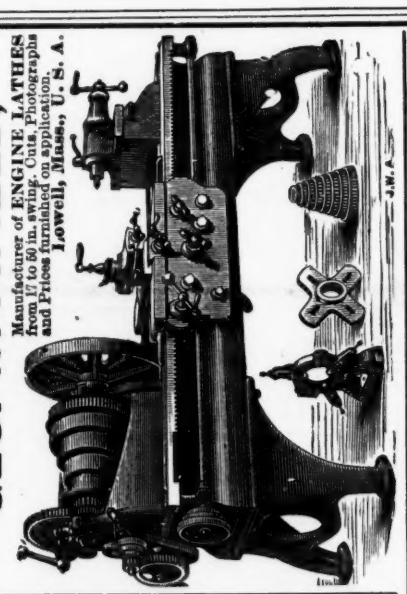

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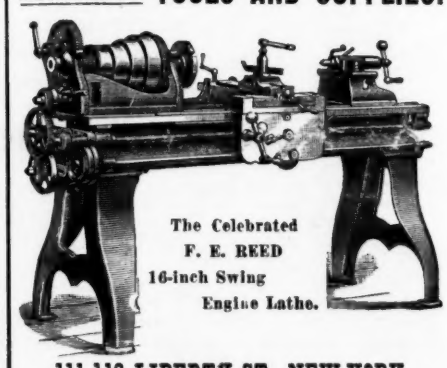

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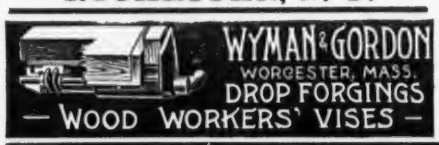

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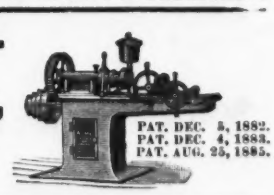

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